

**COMPUTER BASED INFORMATION
SYSTEMS (CBIS) IN THE MANUFACTURING
SECTOR:
A STUDY OF PROCUREMENT,
IMPLEMENTATION, USE AND EVALUATION**

**A THESIS SUBMITTED
IN FULFILLMENT OF THE REQUIREMENTS
FOR THE AWARD OF THE DEGREE
OF
DOCTOR OF PHILOSOPHY**

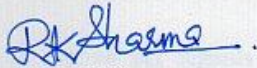
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CERTIFICATE

Certified that the thesis entitled “**Computer Based Information Systems (CBIS) in the Manufacturing Sector: A Study of Procurement, Implementation, Use and Evaluation**” which is being submitted by Mr. Khushdeep Kumar Dharni, in fulfillment of the requirement for the award of the degree of Doctor of Philosophy in the School of Management and Social Sciences, Thapar University, Patiala, is a record of the candidate’s own independent and original research work carried out by him under our supervision and guidance. The matter embodied in this thesis has not been submitted in part or full to any other University or Institute for the award of any degree.



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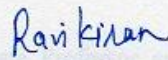
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Abstract

Technology plays an important role in the growth of the manufacturing sector. Successful infusion of IT in the manufacturing organizations depends upon the manner of use and implementation of information systems. The present study is the maiden attempt to explore the procurement, implementation, use and evaluation of Information Systems (IS) in the manufacturing sector of Punjab. The sample for the study consisted of 70 large and medium scale-manufacturing organizations of Punjab. Primary data was collected using two questionnaires developed separately for the organizations and the users. The study included 840 users across various levels and functional areas of management. Results show that the respondents were using IS for around 29.50 hours per week. It was also found that on an average around 64 percent of total decisions being made by the respondents were based on IS. Further, for these decisions sixty one percent contribution of IS based inputs was observed. Respondents reported maximum use of word processor and internet, 12.43 hours per week and 11.85 hours per week, respectively. Results indicate that use of IS is merely restricted to managing routine office activities and communication. Maximum value of IS was observed for decisional roles followed by interpersonal roles and informational roles. For decision making stages, maximum value of IS was reported for 'identification of the problem' followed by 'searching alternatives'. Users relied heavily on IS while making short term decisions while this reliance decreased for strategic decisions. Results from the study indicate that there was a strong efficiency focus in the use of IS in case of the manufacturing sector of Punjab. There was a significant difference across different levels of management in terms of the weekly use of IS. Top level managers were using IS for around 27 hours per week while middle level managers and lower level managers were using IS for 31 hours and 30 hours, respectively. There was significant difference across different functional areas of management in terms of the weekly use of IS. IT managers were the heaviest users of IS with average weekly usage of around 44.30 hours, followed by managers dealing in the area of finance and accounting with weekly usage of 36.80 hours. Hypothesis regarding the variation in the use of IS across different functional areas was substantially refuted and the hypothesis regarding the variations in the use of IS has been partially refuted.

This indicates more variations in the use of IS across the functional areas as compared to the levels of management. In case of functional areas, there is lot of variation in terms of usage rate of IS across the heavy and the light users. This is indicative of difference in the extent of penetration across different pockets in the organization. It was revealed that major reasons for having IS in the manufacturing organizations were elimination of inaccuracies, reducing the cost and integrating various functional areas. Major reason for outsourcing of IS functions in case of manufacturing concerns was to have access to the expertise and the best practices. Security and accuracy were the major factors that affected the selection of IS and vendor. It was found that organizations were very selective in undertaking the feasibility studies before implementing IS. Manufacturing sector in Punjab was found lacking in sound IS management practices. Limited effort of planning for sourcing IS, selective use of feasibility studies and services of external consultants are the major reasons for these relatively poor IS management practices. Methods of evaluation of IS were reported by only two organizations. These included carrying out system audits and dry runs. Using factor analysis, seven factors were extracted for evaluation of IS in the manufacturing sector of Punjab: reliability and speed, accuracy and adequacy, user ability, ease of use, facilitation for work, maintainability and flexibility. These factors have been suggested as the major dimensions for the evaluation of IS in the manufacturing sector of Punjab.

List of Abbreviations

ANOVA	Analysis of Variance
B2B	Business to Business
B2C	Business to Consumer
B2E	Business to Employee
BI	Business Intelligence
BPM	Business Process Management
BPR	Business Process Reengineering
CBIS	Computer Based Information Systems
CEO	Chief Executive Officer
CIO	Chief Information officer
CRM	Customer Relationship Management
CSF	Critical Success Factor
df	Degree of Freedom
DSS	Decision Support Systems
EAI	Enterprise Application Integration
EIS	Executive Information Systems
ERP	Enterprise Resource Planning
ESS	Executive Support Systems
GDP	Gross Domestic Product
HR	Human Resource
HRIS	Human Resource Information Systems
ICT	Information and Communication Technology
IOS	Inter-Organizational information Systems
IS	Information Systems
ISSM	Information Systems Support for Manufacturing
IT	Information Technology
ITeS	IT enabled Services

KWS	Knowledge Work Systems
LAN	Local Area Network
MIS	Management Information Systems
NMCC	National Manufacturing Competitiveness Council
NSDP	Net State Domestic Product
OAS	Office Automation Systems
PC	Personal Computer
RFID	Radio Frequency Identification
ROI	Return on Investment
SAM	Strategic Alignment Model
SISP	Strategic Information Systems Practices
SMEs	Small and Medium Enterprises
TAM	Technology Acceptance Model
TPS	Transaction Processing Systems
WAN	Wide Area Network

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Chapter -1

Introduction

This study deals with the use of Computer Based Information Systems (CBIS) and the practices related to management of these systems such as sourcing, implementation and evaluation in the manufacturing sector of Punjab, a progressive state of India. The present chapter aims to familiarize the reader with the broader issues related to the research. First section of this chapter deals with the definition of computer based information system and second section focuses on the use of this system in business. Second section also provides historical perspective of information systems and their impact on business. Third section captures its dimensions relating to outsourcing, implementation and evaluation. Fourth section includes the present scenario of information technology developments in India. Subsequent sections fifth and sixth provide a brief insight into the manufacturing sector of India and Punjab vis-à-vis other sectors of the economy. Finally need and objectives of this study, and the structure of the document have been presented in this chapter.

Information has touched every sphere of life and has become an inseparable entity in business operations and decisions. Information systems are all pervasive in the modern day organizations, be in form of stand alone systems or in form of enterprise wide applications limited to boundaries of an enterprise or extending beyond organizational boundaries. With decreasing cost of processing and storage, the penetration of computers in business is getting deeper. Business executives have dealt with use of information and information systems for long and are increasingly becoming dependent on technology based applications. It is not uncommon to see routine business activities coming to stand still, if such applications are not available for one reason or the other.

Executives seek information for the purpose of uncertainty avoidance and for dealing with complex decision-making situations. Access to relevant and timely information increases the scope of better decisions. Transactional efficiency achieved by the

enterprise in terms of faster cycle time, lower direct costs and increased accuracy, not only affects process performance but can also be leveraged to have extended impact in the organization.

As organizations grow bigger and more complex, there arises a need for elaborate administrative functions and rules for facilitating the control. Information systems can be useful in exercising the control for large and complex organizations (Cronk and Sharp, 1998).

1.1 DEFINING COMPUTER BASED INFORMATION SYSTEM (CBIS)

Generally, CBIS refers to application software that is used to store data in a computer system and automates the information processing activities in the organization. Application software can be termed as a tool that functions and is operated by means of a computer, with the purpose of supporting or improving the work of the user. Typical examples of application software are word processors, spreadsheets, database applications *etc.* It is worth mentioning here that henceforth the term Information System (IS) shall be used in this thesis, instead of CBIS.

An IS is a particular type of work system that uses information technology to capture, transmit, store, retrieve, manipulate, and/or display information, while, work system is a system in which human participants perform a business process using information, technology and other resources to produce products for internal or external customers (Alter, 1999).

According to Davis and Olson (1985) a management information system is an integrated, user-machine system for providing information to support operations, management, and decision-making functions in an organization. The system utilizes computer hardware and software; manual procedures; models for analysis, planning, control and decision-making, and a database.

Conventional models of the history of Management Information Systems (MIS) suggest that applications progressed from early attempt to automate defined business processes, without making noteworthy changes to business itself, to the increasing complexity of applications involving integration of processes and functions, and leading to the transformation of business itself (Nolan 1983; Galliers and Sutherland, 1991). Initial applications in these models provided the required payback by reducing the costs of the

processes automated by the use of technology. Later on the deployment of technology was based on adding value or gaining advantage over competitors (Porter, 1985).

Nowadays, information systems are not restricted within the organizational boundaries but have spread beyond these boundaries in a bid to engulf both upstream and downstream activities, such as integration with suppliers and customers. Moller (2005) proposed a conceptual framework for Extended Enterprise Resource Planning (ERP II). The proposed framework included integrated database and application framework, ERP and Business Process Management (BPM), Supply Chain Management, Customer Relationship Management, Supplier Relationship Management, Product Lifecycle Management, Employee Lifecycle Management and Corporate Performance Management *etc.* It was argued that inter-organizational integration is crucial for reaping the benefits of ERP II.

1.2 USE OF IS IN BUSINESS

Ever since the invention of the computers, attempts have been made to use it for improving and supporting business. From using the storage capacity to building analytical applications for business benefits, use of computers has become a common feature in modern business enterprises.

McAfee (2006) has categorized Information Technology (IT) in three ways, *i.e.*, Function IT, Network IT and Enterprise IT. Function IT includes technologies that are used for the execution of stand-alone tasks more efficient. These technologies can be adopted without complements, but their impact increases when the complements are in place. Examples of Function IT include spreadsheets, word processors, computer aided design and statistical software. Network IT provides a means by which people can communicate with one another. This technology allows people to interact but do not define the manner of interaction. Network IT brings complements with it but allows the users to implement and modify them over time. Examples of Network IT include e-mails, instant messaging, blogs and groupware. Enterprise IT is adopted by the companies to restructure interactions among groups of employees and business partners. Enterprise IT is purchased and imposed in the organization by the senior management. Enterprise IT can not be adopted without introducing new processes, interdependencies, and decision rights. Examples of this type of IT include ERP, CRM and SCM software.

1.2.1 Historical perspective

Although computer came into being in 1946 and computer based applications became part of business working in the fifties, yet these applications have already traversed a long way in terms of evolution process. In the initial phase, emphasis was placed on using the processing and storage power of the computer. In this phase the major use of computers was hinged around simple calculations and record keeping. In the second phase, the attention was turned from record keeping to analysis. The major change was ushered in 1980s with the introduction of Personal Computers (PCs). PCs were responsible for use of computing power almost in every sphere of life. Introduction of internet added the dimension of connectivity to processing and storage capabilities in the mid nineties, making the use more multi-faceted. Convergence of various technologies is presenting new opportunities for the developers and users in the field of IT.

1.2.2 Impact of IS on Business

Gurbaxani and Wang (1991) examined the impact of information technology on two attributes of the firms, namely, firm size and the allocation of decision rights among the various actors in a firm. The study revealed that a considerable share of the costs was related to the acquisition and processing of information and can be reduced by the application of information technologies. Direction of trends in the location of decision rights is not definitive and depends on other organizational and environmental factors such as the role of information systems in the organization. A firm may use information systems to decentralize some decision rights and to centralize others, so as to exploit the benefits of both the systems and to establish a hybrid structure.

Benefits of information systems have been distinguished in two categories of hard and soft benefits. Hard benefits are usually related to cost reduction, such as the reduction in data entry staff made possible by the introduction of an electronic ordering system or to revenue generation, such as the increased throughput as a result of a new production control system. Problem arises when it comes to measuring the soft benefits, which comprises of three categories, *i.e.*, intangible benefits, indirect benefits and strategic benefits. Intangible benefits can be attributed to a particular application but they cannot be easily expressed in quantitative terms. Benefits of this type arise with the introduction of a Decision Support System. Such systems are primarily expected to improve the quality of decision-making as well as the job structure of their users. Indirect benefits are

primarily easy to measure but cannot be wholly attributable to the proposed investment and can only be realized as a result of further investments, enabled by the new systems. The implementation of a Local Area Network (LAN) across an organization provides the infrastructure on which valuable shared application can later be implemented. Strategic benefits refer to positive impacts that are realized in the long run and usually come as a result of the synergistic interaction among a number of contributing factors. They are the outcome of a new business strategy or a better market positioning of the organization, which can be only partially attributed to a given Information Systems (IS) (Brown, 1994). For realizing the superior benefits from IS, merely putting in place hardware and software is not enough. Because IS performance depends upon a number of collateral assets. Presence of collateral assets supporting IS use may multiply the benefits streams. Efficiency in business processes is necessary but not sufficient in order to be competitive. The changing landscape calls for innovation and experimentation, which in turn require changes in culture, managerial capability and employee skills. IT-application environment oriented towards rapid configuration of business process and work flow technologies is very important for business. As legacy systems are invalidated by new business rules, newer replacements are required. Normally these legacy systems are replaced by enterprise systems that enhance standardization. The challenge is to evolve a flexible infrastructure that supports both capacity to change and standardization in the suitable business processes (Pralhad and Krishnan, 2002).

1.2.3 Managing IS in the organization

According to Bensaou and Earl (1998) a right mindset for managing information technology is a prerequisite to take the maximum benefit. The concept of strategic alignment, whereby information systems are designed as per user needs, arose in the west because many organizations discovered they were developing information systems that did not support their business strategies. But Japanese managers followed strategic instinct, which allows the basic way of competing and ensures that the operational goals drive IT investments. Strategic instinct is considered even better approach for managing information systems as compared to strategic alignment. Hence the right mindset for managing information systems will ensure that the focus of investment is on performance

improvement with help of appropriate technology emphasizing human designs and supported by organizational bonding between specialists and users.

For effective IS investments, it becomes important that crucial decisions related to investment are made by senior managers. Persons with IT expertise should primarily take technical decisions such as choice of the technology standards, design of IT operations centre, required technical expertise and methodology for implementing the new systems. Instead of approaching IT decisions in the ad-hoc manner companies are increasingly establishing formal IT governance structures that specify how IT decisions are made. On the strategy front, decisions such as expenditure on IT, allocation of IT budget to business processes and the need for companywide IT capabilities must primarily be the responsibility of senior managers. On the execution front, issues such as level of IT services, security and privacy risks associated with IT and fixing responsibility for IT performance should also get due consideration from top management (Ross and Weill, 2002).

Enterprise decisions can be examined broadly from two perspectives, as output (pursuit for making better decisions) and as process (pursuit for better decisions making). As information is merely one of many inputs used for decision making process, availability of timely, relevant and accurate information can stimulate the process quality in partial manner. As degree of timeliness, relevance and accuracy of information goes on increasing, decision maker is in better position to make decisions. This situation leads to enhanced process quality or better “decision making”. On the other hand, it is possible that the same information, available to different decision makers, leads to decisions differing in output quality. Simply because making “better decisions” not only depends upon availability of quality information, but is also affected by a great deal on how the available information is being used. Further, uncontrollable factors affecting the outcome along with the non availability of complete information also ensure that there can be distortions moving from process stage to output stage. Individual cases may have a high degree of incongruence between process quality and output quality but on an average increase in process quality is expected to lead to increased output quality and vice versa.

1.3 EXPLORING DIMENSIONS OF IS IN BUSINESS

The following section deals with various dimensions of IS/IT in business like types of applications and issues such as: outsourcing, implementation and evaluation of IS/IT in the business enterprises.

1.3.1 *Categories of information systems*

Information systems can be classified into four different categories based on the following organizational levels:

- Operational Level
- Knowledge Level
- Management Level
- Strategic Level

Further, these four levels are spread across different functional areas like Human Resource, Finance, Accounting, Production, Sales and Marketing *etc.* These four levels of information system are discussed below:

Operational Level Systems: These are used by operational level workers to perform day-to-day routine activities. These elementary activities performed on daily basis may include cash deposits, material receipts and issues, payroll and credit decisions. Information from these systems should be easily accessible, updated and precise. The basic purpose of operational level systems is to answer very routine questions like queries related to cash in hand, daily material issue, day's attendance record, number of latecomers, sales made to a particular customer, amount outstanding for an account *etc.*

Knowledge Level Systems: Information systems being used by knowledge and data workers are known as knowledge level systems. Knowledge and data workers are the data generating nodes in any organization. The basic aim of information systems at this level is to integrate and assimilate new knowledge into the business and help the organization to maintain control over information flow activities. Computer workstations and office systems belonging to this level find an organization wide application.

Management Level Systems: These systems help in managerial functions of planning, organizing, monitoring and directing activities at middle level management. These systems are used for generating periodic reports so as to ensure that the activities in the organization are going as per plan. The instances of not completing the sales target and non-conformance to budget standards are typical examples of such activities. Apart from

noting deviations, the systems are also used for supporting managers in answering non-routine decision situation. “What if” types of questions are answered like: What will be increase in sales if advertising budget is doubled? By shifting focus from print media to electronic media what are the expected savings keeping the level of sales unaltered? Both internal and external data are required for responding to such questions and the systems tend to provide a range of solutions for different decision situations involving change of conditions and constraints.

Strategic Level Systems: Top level managers make use of strategic level systems for which data availability and dependence is outward up to a great extent. The systems help in matching organizational strengths with opportunities and evading threats existing in the environment. Long-term sales trends, state of economy in the coming five years, product mix shape in the coming decade can be some issues related with strategic level systems.

More specifically, there are six major information systems related with four levels of organization. These major information systems are: -

- Transaction Processing System (TPS)
- Office Automation System (OAS)
- Knowledge Work System (KWS)
- Decision Support System (DSS)
- Management Information System (MIS)
- Executive Support System (ESS)

Transaction Processing Systems: These are the computerized systems engaged in performing and recording daily routine transactions vital for conducting day-to-day business. These operational level systems are used for recording transactions and events. Processing mainly involves sorting, listing, merging and updating of transaction data. Transaction processing systems generate detailed reports and summaries and can also be used to produce lists of events. Clerks and accountants in a business organization use TPS to generate daily accounts receivable, daily outstanding orders *etc.*

Office Automation Systems: These systems involve use of word processing, imaging of documents and electronic calendars for supporting organization wide activities. The systems are used mainly for document storage and management. Communication via

intranet, Local Area Network (LAN), Wide Area Network (WAN) and e-mail are part of office automation systems.

Knowledge Work Systems: These systems are responsible for aiding knowledge workers in the creation and integration of new data, information and knowledge in the organization. Knowledge workers are concerned with data and knowledge creation in the organization. Normally, these people are professionals, *e.g.*, scientists, researcher, engineers, lawyers *etc.* Various applications of KWS involve word processing, desktop publishing and document imaging systems.

Management Information Systems: MIS help the management level of the organization by providing services for functions of planning, controlling and decision-making. By using MIS, managers can have access to current as well historical performance of the firm. MIS has to depend upon TPS to a great deal to provide weekly, monthly and yearly reports to managers. Simple routines like summarization and comparative analysis are used to provide information.

Decision Support Systems: These systems are designed to support the decisions at management level. These systems are designed to be adhoc, guide response systems. Managerial decision-making is not replaced but supported by the use of analytical modeling techniques and display graphics. DSS support managers in decision making by iterative processes and are used mainly for semi structured and unstructured decisions.

Executive Support Systems: These systems serve the strategic level of organization. Senior managers use these systems for addressing non-routine decisions. These can be defined as information systems that serve the needs of top executives and include communication, office automation, analysis support and business intelligence. The data and information processed in these systems are both external and internal to the firm. These support decisions may pertain to competitive strategies, mergers and acquisitions, entering new business *etc.*

With increased standardization, at least at transaction level, the focus of organizations seeking competitive advantage through decision making is expected to shift to DSS and ESS. In the long run, higher order systems such as DSS, ESS and expert systems will not

be able to sustain competitive advantage simply because of the likely emergence of dominant design in the field and ubiquity.

1.3.2 Outsourcing

Outsourcing is the process by which a corporation, a governmental agency or another business entity subcontracts to a third party the performance of certain services or the operation of certain equipment required for its internal operations (Gilbert, 1993). IT outsourcing is a major issue facing managers in today's rapidly changing business environment. IT outsourcing is not a new phenomenon. It has existed since long in various forms such as service bureaux, time sharing or facilities management. Off late, it is attracting the attention because of expanded size and scope of outsourcing activities. Outsourcing has grown to point where it includes a wide spectrum of IT functions, including long-term contracts for managing the core of a firm's IT operations with transfer of IT assets to the vendor (Jurison, 1998).

The outsourcing for IT services has been increasing both in public and private sectors. It has been seen that well defined IT requirements by the organization lead to better performance when such services are outsourced (Domberger *et al.*, 2000). Weeks and Feeny (2008) have termed IT outsourcing as twenty years old. An attempt has been made for discovering the relationship between IT outsourcing and innovation. In context of IT outsourcing, innovation has been divided into three categories namely, IT Operational, Business Process and Strategic. IT Operational innovations can be defined as the developments that involve technology changes not impacting firm-specific business processes. Examples for IT Operational innovations include new operating systems, addition of new hardware *etc.* Business Process innovations involve change in the way of running the business. These may involve introduction of Radio Frequency Identification (RFID) and Enterprise Resource Planning (ERP) in the firm. Strategic innovations significantly enhance the firm's product/service offerings for existing customers or facilitate entry in new markets. Over a period of time, firms usually follow a learning curve with three stages. First stage of learning is the 'cost focus' stage. In this stage, IT is treated as a commodity and IT function and activity are treated as 'non-core' part of the business. During this stage, the major focus of outsourcing is to reduce cost. Second stage, is termed as 'quality focus' stage. This stage involves the growing realization on

part of the firm that some of the IT activity is underpinning business critical activities and the emphasis shifts from cost to 'fitness for purpose'. Third stage on the learning curve is 'innovation focus' stage. This stage focuses on added business value through innovation. Usually, the firms realize in the third stage that IT is a potential enabler of new business value.

Managers believe projected economic benefits to be key drivers behind outsourcing of information systems. Because in-house development and applications are often seen as being too long, too costly, exceeding budgets and producing systems which mismatch with real requirements (Fowler and Jeffs, 1998). Usually, companies focus their efforts on their competence and tend to subcontract other activities to outsiders (Weidenbaum, 2005).

There are a number of reasons for outsourcing IT activities. Major reasons for outsourcing IT activities include:

- Technological considerations such as integration requirements and non availability of skills in-house
- Cost savings
- Strategic considerations
- Human resource considerations
- Consolidation of data centres

Apart from cost savings, other aspects such as strategic impact and technical flexibility also play important role in the outsourcing decisions (Saunders *et al.*, 1997).

In context of outsourcing, a company's overarching objective should be to maximize flexibility and control, so that with change in circumstances more options can be pursued. Managers should not make one time decision regarding whether to outsource or not. Rather, an attempt should be made to create an environment in which potential suppliers and internal IT departments are in competition to provide IT services. IT can be treated as a business critical activity, but this notion should not completely restrict outsourcing. The following questions should be answered by the managers while making sourcing decision:

- Is the IT system truly strategic?

- Is there a certainty that IT requirements of the organization will not change overtime?
- Is it possible to break off an IT system in order to take up selective outsourcing?
- Could the internal IT department provide this system more efficiently as compared to an outsider?
- Does the company have the knowledge to outsource an unfamiliar or emerging technology?
- How to design a contract so as to minimize the risk and maximize control and flexibility?

Accurate answers to such questions will ensure better IT outsourcing and management in the organization (Lacity *et al.*, 1995).

For successful outsourcing it is not enough to know the company's needs but there is a need to look into the capabilities of the suppliers as well. It is important to understand three types of supplier competencies, *i.e.*, delivery competency, transformational competency and relationship competency. Delivery competency deals with the ability of the supplier to respond to operational requirements of the client such as cost, quality, robustness and flexibility. Transformational competency covers the ability of the supplier to meet formal and informal expectation of the client over a longer period of time. Relationship competency encompasses the ability of the supplier to cultivate a relationship that is built on alignment of client and supplier goals (Feeny *et al.*, 2005).

Michelman (2005) has argued that executives are seeking to establish repeatable formulas to mitigate risk and maximize reward in case of IT outsourcing. The following checklist has been proposed for outsourcing by him:

- Make an outsourcing decision based on strategic goals and not just on tactical urgency
- Domain knowledge should be retained by the outsourcing organization
- Design an exit strategy for the termination of the outsourcing contract
- Communicate fully with the current employees to overcome user resistance
- Build joint company-vendor teams
- Invest in a robust vendor selection process
- Define appropriate performance measures for the outsourcing activity

When companies consider buying a new product the perceived characteristics of the product play an important role in the final decision to start using a new product (Rogers, 1995). Normally the criteria used while purchasing an information system are support, scalability, user friendliness, cost, flexibility and fit. The most important criterion used for selecting information system is ‘the best fit’ with current business procedures. Therefore, a successful information system should have compatibility with the business procedures. Other important selection criteria are flexibility, cost and user-friendliness of the system and to a lesser extent scalability and supplier support. The criteria used to select supplier of new information system include functionality of the product, product quality, speed of implementation, price, market leadership, corporate image, international orientation and interface with other systems. While sourcing information systems it has been seen that companies tend to focus on product characteristics rather than on characteristics of suppliers (Everdingen *et al.*, 2000).

According to IDC India (2009), traditional IS outsourcing is going out of fashion and “Risk and Reward” deals are getting popular. To cater to the changing scenario, service providers are launching low-cost, highly flexible service delivery platforms that provide product based services to customers by leveraging commoditized technology (www.idcindia.com/press/growth_2009.html).

1.3.3 Implementation of IS

Information systems are usually termed as man-machine systems. Given the advances in technology, it may seem that man component has taken a back seat. But, the human factor is proving to be the differentiator in degree of success achieved by various organizations in using information systems. With increasing standardization, the human factor is definitely going to assume greater attention in time to come. Ignoring the user in information system development and implementation may cripple the potential benefits of IS. According to Alter (1976) managers have little say in development of Decision Support Systems and non-managers who develop these systems have limited view of how they can be used. Difference between success and failure of these systems depends upon the extent to which managers can use the systems to increase their effectiveness within the organization. Phenomenon of not involving business managers in IS related decisions, IS development and IS implementation is still very much in fashion. This lack of

participation often leads to higher user resistance and lack of trust on part of user amounting to underperforming systems in the organizations.

Critical Success Factors (CSFs) play an important role in the implementation of information system across the different phases. Top management support, project team competence, inter-departmental co-operation, clear goals and objectives as well as project management are the key factors in the implementation of IS (Somers and Nelson, 2001).

Top management support in implementation of IS is expected to lead to more successful use of computers in both large and small business. Top management support may be present in the form of planning and participation in implementation activities. Top managers can support IS implementation by means of resource allocation so that the efforts are not choked for want of resources (Thong *et al.*, 1993).

Most of the companies are not succeeding in turning data into knowledge and then results. In a rush to use computers for all transactions, most organizations have neglected the most important step in the data transformation process, *i.e.*, the human realm of analyzing and interpreting data and then initiating actions on the basis of available insight. Companies usually emphasize on technology and data infrastructure while ignoring the organizational, cultural and strategic changes needed for supporting technology led initiatives (Davenport *et al.*, 2001).

There can be significant difference in the adoption process and outcomes despite the similarities in the scale of operations and cultures of the organizations. Some organizational factors like top management commitment, unions, middle management participation and capabilities of IS professionals can be responsible for such differences. Cultural aspects must be considered for successful implementation of IT adoption (Tarafdar and Vaidya, 2005).

For successful implementation of IS, the existence of positive, realistic and compatible expectations held by system developers, users and managers are absolutely necessary. These expectations in turn depend upon the competences shown both in system design and system implementation (Abreu and Conrath, 1993).

For successful IT management the following principles have been proposed (McAfee, 2004):

- (i) IT is an aid to judgment, not a substitute for it.

- (ii) Computerization is standardized and targeted.
- (iii) Technology initiatives begin from within.
- (iv) The process is the focus.
- (v) Alignment is pervasive.

When aligned and managed properly, IT provides benefits such as process standardization and alignment, assurance of compliance with the new processes and attains tasks like optimization, automation, monitoring, analysis and control that are otherwise difficult to attain.

Increasingly companies are moving from developing of IT systems in-house to purchasing prepackaged software. There are different strategic approaches to ERP software implementation. Two main technical options are the implementation of a standard package with minimum customization and considerable customization of software to suit the local needs. ERP implementation encompasses a number of dimensions such as strategic, organization and technical. Implementation of ERP involves a mix of business process change and software configuration to align the software with existing business processes. Implementation is broadly affected by two factors, *i.e.*, strategic factors and tactical factors. Strategic factors include understanding and evaluation of legacy systems and ERP strategy. Understanding of legacy systems is crucial for finding out the organization's propensity to change. ERP strategy deals with the manner and speed of implementation. Tactical factors include client consultation, monitoring and feedback regarding implementation (Holland and Light, 1999).

Successful deployment of IT in an organization requires heavy investment in a wide range of complementary assets to support the technology coupled with the patience to wait for these investments to pay off. It has been shown that a combination of the IT assets and the relevant set of complementary assets in terms of available human skills, new organization structures and new work processes can lead to new services and products yielding competitive advantages (Hughes and Morton, 2006). Misalignment between business logic and system logic acts as a dampener for realizing the potential benefits of information systems for misalignment leads to poor performance of enterprise and system (Shpilberg *et al.*, 2007).

Enterprise systems often fail to deliver because of the inability of the companies to reconcile the technology imperative with the business needs of the enterprise itself. If

logic of the system being implemented is in conflict with the logic of business it may result into implementation failure or the erosion of the sources of competitive advantage available to the firm. It is important that organizations give due attention for emphasizing ‘enterprise’ while implementing enterprise systems and do not focus only on ‘system’ (Davenport, 1998).

1.3.4 Evaluation of IS

Although returns to IT investments are positive on average, there is a wide range of performance among different companies. These differences can be explained by idiosyncratic firm differences that result in different opportunities to use IT productively. There is strong evidence that investments in organizational capital through management practices *viz.* decentralization, training and business process restructuring have an impact on returns to IT investment. IT should not be seen as merely a tool for automating the existing processes, but is more importantly an enabler of organizational changes that can lead to productivity gains (Dedrick *et al.*, 2003)

Increasing competitive impact of information systems has made IT more important for senior managers. Strategic investment in IT is different from investments undertaken for automating the office activities and reducing cost. Developing a strategic IT application involves making a company more flexible, more responsive to customer needs or increasing the ability to adapt to rapidly changing conditions in the competitive environment. The strategic impact of information systems poses a new challenge to MIS management.

The most commonly cited causes of the difficulty to evaluate IT investments include the following (Parker *et al.*, 1988, Strassman 1990, Farbey *et al.*, 1992, Banker *et al.*, 1993):

- The intangible nature of the IT benefits.
- Benefits of IT are realized in the long run but firms use evaluation criteria that are suitable only for short run.
- The real benefits of IT are strategic and competitive advantages, which are inherently difficult to quantify.
- The benefits of IT are indirect to business or society and therefore indistinguishable from many other confounding factors.
- The theories and techniques available are inappropriate for understanding and capturing the value of information systems.
- The level of analysis is normally concentrated out of focus, *i.e.*, either too general or too narrow.

1.4 SCENARIO OF IT/IS IN INDIA

According to IDC India (2009) first phase in domestic IT industry is almost over. This phase was focused on the IT infrastructure build up and consolidation. Next phase is expected to see the leverage of consolidated IT infrastructure to exploit the potential benefits of IT applications Domestic IT / ITeS industry in India is expected to grow at 13.4 percent in 2009 (www.idcindia.com/press/growth_2009.html).

Table 1.1 depicts production figures related to electronics and information technology in India. It can be seen from the table that from 2002-03 to 2007-08, there has overall been an increase of about 200 percent, *i.e.*, from Rs. 97000 crore to Rs. 291100 crores. Further, it can be seen that for the same period the growth in electronics and communication hardware (shown as sub total) was recorded at 115.4 percent. These growth figures indicate the increased use of computer and electronics items in India.

India has emerged as a hub for creation of software globally over the last decade. It can be seen that growth in domestic software has been able to keep pace with software exports from 2002-03 to 2007-08. Software for exports clocked a growth of 253.5 percent during this period, while the growth figure for domestic software stood at 252.9 percent.

Table 1.1: Electronics and IT Production in India (Rs. Crores#)

Item	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08
Industrial Electronics	5550	6100	8300	8800	10400	11950
Consumer Electronics	13800	15200	16800	18000	20000	22500
Computers	4250	6800	8800	10800	12800	16400
Comm. and Broadcast Eqpt	4800	5350	4800	7000	9500	14350
Components	6600	7600	8800	8800	8800	9500
Strategic Electronics	2500	2750	3000	3200	4500	6100
Sub Total	37500	43800	50500	56600	66000	80800
Software for exports	46100	58240	80180	104100	141000	163000
Domestic Software	13400	16250	21740	29600	37000	47300
Grand Total	97000	118290	152420	190300	244000	291100

(Source: Annual Report 2007-08, Department of IT, Ministry of Communication and Information Technology, Government of India) #1 Crore = 10 million

Another point worth mentioning is that in 2007-08 domestic software recorded a growth of 27.8 percent which is higher than growth rate of software for exports at 15.6 percent.

It can be seen from Table 1.2 that total IT /ITeS (IT enabled Services) market for India grew at 17.3 percent to reach the revenue figure of Rs. 1,01, 031 crore in 2008 from Rs. 86,101 crore in 2007. domestic IT industry grew at 15.4 percent in 2008 to report revenue of Rs. 94,185 crore. Domestic ITeS industry clocked a growth of 53.2 percent in 2008 to report revenue of Rs. 6846 crores .

Table 1.2: India Domestic IT/ITeS Market Size (Rs. Crores)

Market Segment	2007	2008	2009*
Software	7823	9628	11300
Services	20920	25092	29934
Hardware and Others	52890	59465	63703
Total Domestic IT Market	81633	94185	104937
Total Domestic ITeS Market	4468	6846	9637
Total Domestic IT/ITeS Market	86101	101031	114574

* Projected Figures (Source: IDC India, www.idcindia.com/press/growth_2009.html)

According to IDC, total India domestic IT services market was approximately 5.85 billion US dollars in 2007. Out of this, approximately 20 percent share was contributed by Managed IT services. Earlier, large enterprises were the users of Infrastructure Management Services (IMS) because of their need to outsource the management of complex IT infrastructure. But now, even the mid size firms are also looking to outsource this function so as to focus on the core activities of their business (www.idcindia.com/press/may2.html).

1.5 INDIAN MANUFACTURING SECTOR

Manufacturing has been recognized as the main engine for economic growth and creation of wealth, thus emphasis was placed on growth of industry in most of five-year plans. Manufacturing is crucial to Indian economy. The effect of improvement in manufacturing goes far beyond its production. Manufacturing spurs demand from raw material to intermediate goods as well as services like transportation, health, financial and other

services. Although contribution of Indian manufacturing is not yet very high but its pace of growth remains crucial for overall growth of Indian economy.

Further, manufacturing sector will have to carry the responsibility of increasing employment opportunities for the young Indian work force in times to come. Growth of manufacturing sector is equally important for the agriculture with focus on the agro-based industries. Especially growth of food processing sector will lead to more employment opportunities for rural youth. Indian manufacturing in 2002 was contributing about 15.22 percent to GDP (Gross Domestic Product); this share was far less as compared to China (35%), Thailand (34%) and Malaysia (31%).

Table 1.3 presents progress of Indian economy and manufacturing sector from 2000-01 to 2006-07. It can be seen from the table that good growth in manufacturing sector accompanies better performance of overall economy. For 2005-06 and 2006-07, Indian economy was able to manage a growth rate of plus nine percent. These two years also witnessed growth rate of 8.98 and 12 percent respectively for the manufacturing sector.

Table 1.3 Indian Economy and Manufacturing Sector (Rs. Crores)

Year	GDP at constant prices 1999-2000 in Rs. Crores	GDP Growth (%age)	Manufacturing in Rs. Crores	Manufacturing Growth (%age)	Share of Manufacturing in GDP
2000-01	1864300	-	284571	-	15.26
2001-02	1972606	5.81	291803	2.54	14.79
2002-03	2048287	3.84	311685	6.81	15.22
2003-04	2222758	8.52	332363	6.63	14.95
2004-05	2388384	7.45	361115	8.65	15.12
2005-06	2612847	9.40	393557	8.98	15.06
2006-07	2864310	9.62	440770	12.00	15.39

(Source: Handbook of Statistics on the Indian Economy, Reserve Bank of India 2007-08)

A glimpse of the table also reveals average performance on part of Indian manufacturing especially in 2001-02 and 2003-04 as compared to overall economy. Growth figures in

Indian manufacturing for these eight years lack consistency. Further, over this time period share of manufacturing in overall economy has remained stagnant.

Table 1.4 provides a comparison of manufacturing sector in India with other sectors of the economy. Maximum share in Indian GDP comes from service sector followed by agriculture and allied sector. Share of agriculture in Indian GDP is declining continuously and this decline is reflected in consistent growth in the service sector. It seems that economic activity is shifting agriculture to service sector, while the share of manufacturing sector in GDP has remained almost unchanged.

It can be seen that the manufacturing sector is the main driver of the industry sector in India. But except for 2006-07 manufacturing sector has been outperformed by service sector. For 2001-02 and 2003-04, even agriculture sector was able to clock higher growth as compared to manufacturing sector.

Table 1.4: India Manufacturing vis-à-vis Other Sectors: Share in GDP and Growth

Year	Agriculture and Allied		Manufacturing		Industry		Service	
	Share	Growth	Share	Growth	Share	Growth	Share	Growth
2000-01	23.89	-	15.26	-	19.99	-	56.12	-
2001-02	23.99	6.25	14.79	2.54	19.33	2.35	56.68	6.85
2002-03	21.43	(7.24)	15.22	6.81	19.88	6.79	58.69	7.52
2003-04	21.72	9.96	14.95	6.63	19.42	6.00	58.86	8.84
2004-05	20.20	(0.05)	15.12	8.65	19.61	8.51	60.19	9.87
2005-06	19.56	5.92	15.06	8.98	19.37	8.02	61.08	11.01
2006-07	18.51	3.76	15.39	12.00	19.54	10.63	61.94	11.18

(Source: Handbook of Statistics on the Indian Economy, Reserve Bank of India 2007-08)

India's share in global trade is less than one percent and manufactured goods form three-fourth of all exports from India. For growth of Indian economy, manufacturing sector is crucial and in future competitiveness of Indian manufacturing sector will prove to be decisive for direction of growth of Indian economy. In the recent past, manufacturing sector in India has been impacted by global as well as domestic developments.

Substantial reduction in trade barriers particularly in respect of manufactured goods both globally and within India, technology revolution impacting productivity and emergence of technology driven low cost manufacturing hubs like China and Taiwan are few major factors challenging the Indian manufacturing to go through major adjustments and changes. India possesses a comparative advantage in terms of experienced work force, large pool of technical and management professionals, endowment of natural resources, and a large domestic market for consumption. Given these factors there is no denying of the fact that India has the potential to become a competitive manufacturing hub on the global map. Innovation and prudent use of technology is the key to productivity and productivity ultimately enhances competitiveness. Achieving competitiveness remains central to the robust growth of the Indian manufacturing and any underachievement on this front is not going to help growth of Indian economy in times to come.

After an overview of Indian manufacturing the following section provides a glimpse of manufacturing sector of Punjab.

1.6 MANUFACTURING SECTOR IN PUNJAB

It can be seen from Table 1.5 that Net State Domestic Product (NSDP) of Punjab increased from Rs. 63182 crores in 2000-01 to Rs. 81376 crores in 2006-07.

Table 1.5: NSDP of Punjab and its Manufacturing Sector (Rs. Crores)

Year	NSDP at constant prices 1999-2000 in Rs. Crores	NSDP Growth (%age)	Manufacturing in Rs. Crores	Manufacturing Growth (%age)	Share of Manufacturing in NSDP
2000-01	63182	-	8495	-	13.45
2001-02	64000	1.29	7844.1	(7.66)	12.26
2002-03	65360	2.13	8307.7	5.91	12.71
2003-04	68842	5.33	8613.5	3.68	12.51
2004-05	72446	5.24	8985.2	4.32	12.40
2005-06	76491	5.58	9782.5	8.87	12.79
2006-07	81376	6.39	10344	5.74	12.71

(Source: Handbook of Statistics on the Indian Economy, Reserve Bank of India 2007-08)

During the same period manufacturing sector in Punjab moved from Rs. 8495 crores to Rs.10344 crores. It can be seen that growth rate in manufacturing has been lower than that of overall economy except for 2002-03 and 2005-06. It can be observed that share of manufacturing in net state domestic product has slowed down from 13.45 percent in 2000-01 to 12.71 percent in 2006-07. In 2001-02, manufacturing in Punjab recorded a negative growth of 7.66 percent. Punjab is an agrarian state and considerable contribution to its economy comes from agriculture.

Table 1.6: Punjab State Manufacturing vis-à-vis Other Sectors: Share in NSDP and Growth

Year	Agriculture and Allied		Manufacturing		Industry		Service	
	Share	Growth	Share	Growth	Share	Growth	Share	Growth
2000-01	39.10	-	13.45	-	15.22	-	45.68	-
2001-02	38.81	0.53	12.26	-7.66	13.88	-7.59	47.31	4.90
2002-03	37.41	-1.55	12.71	5.91	14.45	6.29	48.14	3.92
2003-04	37.57	5.77	12.51	3.68	14.28	4.08	48.15	5.36
2004-05	36.42	2.01	12.40	4.32	14.39	6.08	49.19	7.50
2005-06	35.09	1.73	12.79	8.87	14.83	8.77	50.08	7.50
2006-07	34.32	4.04	12.71	5.74	14.76	5.88	50.93	8.18

(Source: Handbook of Statistics on the Indian Economy, Reserve Bank of India 2007-08)

Further, it can be seen that growth rate of Punjab economy is less as compared to national economy. Table 1.6 presents the comparison of manufacturing sector with other sectors in case of Punjab.

1.7 NEED FOR THE STUDY

According to National Manufacturing Competitiveness Council (NMCC), the current stage of Information and Communication Technology (ICT) in Indian manufacturing sector is not encouraging. Lack of global competitiveness in this sector can be partly attributed to lack of adequate ICT enablement of business processes and management

practices. For most of the manufacturing organizations the use of ICT is limited to automation of specific functions like inventory control, external communication *etc.* In case of small and medium enterprises, ICT is not being leveraged to the full potential and ICT is still being used as office administration and accounting automation tool. There is a need for functional automation and cross functional process integration. ICT can act as a powerful enabling technology with the potential to significantly improve the global competitiveness of Indian manufacturing sector. While adopting ICT applications, the major emphasis should be on improvement of business activities (The National Strategy for Manufacturing, March 2006, Government of India, National Manufacturing Competitiveness Council).

Technology Management and use of Information and Communication Technologies are important for developing competitiveness of Indian manufacturing. Many manufacturing organizations in India are at nascent stage as far as Technology Management and use of Information and Communication Technology is concerned. Lack of knowledge about the potential of Information Technology for business performance improvement and the absence of enterprise wide applications are proving to be bane of Indian manufacturing sector.

Manufacturing sector in India is contributing less to the economy, as compared to other sectors. This trend is not there in other developing countries such as China, Thailand and Malaysia. The scenario further takes a grimmer look in case of the state of Punjab. At present, manufacturing can not be seen as a viable alternative because of its declining share in NSDP as well as lower average growth rate as compared to the service sector. But for the progress of Punjab economy in the long run, it becomes imperative that share of manufacturing in NSDP should increase. This can be possible by improving the performance of the manufacturing sector by better IS use and its management. Present study attempts to find out the state of use and management of IS in Punjab so that the opportunities for improvement can be identified.

1.8 STATEMENT OF THE PROBLEM

The present study aims at studying the procurement, implementation, use and evaluation of the IS in the manufacturing sector of Punjab. Hence the study has been titled as **‘Computer Based Information Systems in the Manufacturing Sector: A Study of Procurement, Implementation, Use and Evaluation’**.

1.8.1 Objectives of the study

The following objectives were finalized for the study:

1. To find the type and extent of use of IS with respect to level of management and functional areas of management
2. To study the methodologies and procedures in the implementation of IS
3. To study the process of procurement and the attributes considered for purchase of Computer Based Information Systems in the manufacturing sector of Punjab
4. To study the process of evaluation of IS and suggest an evaluation model for IS.

1.9 DOCUMENT STRUCTURE

This document consists of five chapters and three annexures. The current chapter introduces the concept and covers various issues. Second chapter reviews the relevant literature on IS in order to find major issues of IS research. Third chapter covers the research questions and the methodology adopted for carrying out the study. Fourth chapter presents the results obtained from the study. Fifth chapter summarizes the study, answers the research questions and presents the implications as well as major contributions of this work.

1.10 CHAPTER SUMMARY

The present chapter has outlined the major dimensions of IS related to the present research. State of IT industry in India and the manufacturing sectors of India and Punjab have been presented. In context of Punjab, it can be stated that manufacturing sector has to contribute more to growth. It can be inferred that the manufacturing sector has to contribute more to growth of this state. In this chapter, the need for the study and the objectives of the study have also been presented.

This chapter presents the review of literature related to the present study. IS literature has been reviewed to know about the developments in the theory and practices in the field of IS. An attempt has been made to identify the major themes related to the use, sourcing, implementation and evaluation of IS, with the aim to find out the basic issues for exploring IS use and management practices in the manufacturing sector of Punjab. This chapter has been organized in three sections, namely, sourcing and implementation of Information Systems; use and benefits derived from Information Systems; and evaluation of Information Systems, based on the objectives of the study.

Major themes of IS research have been captured and presented in tabular form at the end of each section so as to get an overview of the important studies that are included in the respective sections. Research gaps have been identified to be covered in the study.

2.1 SOURCING AND IMPLEMENTATION OF INFORMATION SYSTEMS

Palvia and Palvia (1990) have made a comparison of Information Systems (IS) issues between United States and India. The major differences found were that while developing nations like India were still struggling with the operational issues and were not concentrating on strategic issues, United States companies were focusing on issues like strategic planning for information systems, gaining competitive advantage and realization of data as corporate resource.

Abreu and Conrath (1993) proposed a model regarding the role of stakeholders' expectations in predicting systems implementation outcomes. Systems implementation was treated as a process of technological innovation and organizational change, in which stakeholders' expectations about the changes caused by the system introduction play a major role in determining the process's outcomes. The model was derived from existing literature at that time and made use of all the three streams of IS implementation, *i.e.*, factor, process and expectancy studies. The fundamental premise was that the pre-condition for IS implementation success is the existence of positive, realistic and

compatible expectations held by each of three stakeholder groups, *i.e.*, system developers, users and managers.

Bajwa *et al.* (1993) presented a conceptual framework integrating strategy, structure and information technology using the context of choosing an appropriate computer based systems configuration for an organization. Authors have further argued that in addition to strategy, organizational structure is an important dependent variable in the choice of computer based systems configuration and that the macro organization structure would be more difficult to change than computer based systems configuration. Configuration of computer based systems is defined by IT elements and the orientation of computer based systems. Key IT elements are considered to be a function of organizational structure while the orientation of computer based systems is function of organization's strategic mode. Orientation of systems can vary in terms of four bipolar informational variables. For example, defenders are likely to emphasize internal, past, control and efficiency orientation, while prospectors are likely to emphasize on external, future, planning and effectiveness orientation. Between these two extremes, reactors and analyzers emphasize some combination of both the extremes but differ in relative importance placed on the extreme properties of the four variables.

Earl and Feeny (1994) argued that to make the information systems department an asset to their companies and to keep their jobs, Chief Information Officers (CIOs) should think of their work as adding value in certain key areas. Accordingly, Chief Executive Officers (CEOs) can take a number of steps to aid CIO's efforts. Authors have described how CEOs tend to be polarized in their views of the value for money being delivered by IT. In recent years, there has been a tendency among organizations, these view IT as a liability to resort to outsourcing of the IS functions. This action may reduce IT costs, at least in the short term, but it does nothing to change the dominant variable, the value being delivered by IT. Organizations where IT is viewed as an asset, where IT plays a role in transforming the business, have quite a different IT environment. This environment is not achieved by outsourcing. It is achieved primarily by the actions and qualities of a value-adding CIO, irrespective of whether the bulk of IT activity is outsourced or remains in-house.

Jordan and Tricher (1995) emphasized that information systems strategic planning tackles the general problem that organizations have of determining where and how to develop information systems and apply information technology. Alignment of IS strategy with the business needs has been an important issue in organizational planning. It was found that there is a feasibility of aligning information strategy with organizational structure.

Noble (1995) has argued that technology implementation strategy must begin with identification of the potential benefits. Office information systems have generally been regarded as administrative support rather than strategic systems. However with advances in technical integration, office systems are developing from a rather narrow conception of office automation into organization wide system which do have strategic significance. An implementation strategy must also consider the organizational implications and how to deal with them. Integrated systems have more organizational impact than earlier departmental systems. In some cases, strategic office system requires extensive organization redesign. Traditional methodologies need to be supplemented by change management approach which can deal with second order change, such as organizational transformation. Four broad types of strategic application of office information systems are used. From an information perspective, office serves the vital needs of organization in three areas: primary (perform the core value-adding task of the organization), boundary-spanning (handle relations with the environment) and co-coordinative (manage the relations between the other two and among organizational units).

While studying linkage between business and information technology objectives, Reich and Benbasat (1996) identified two major issues. Firstly, to clarify the nature of linkage construct and secondly to develop and test measures of the social dimensions of the linkage. Linkages construct was found to have two dimensions namely, intellectual () and social. Intellectual dimension conveys that the context of information technology and business plans are internally consistent and externally valid and social dimension conveys that the information system and business executives understand each others objectives and plans.

Sheth (1996) stated that purchasing function is dramatically shifting from the transaction oriented to the relational oriented philosophy and it is also shifting from domestic to global sourcing.

Lee and Kim (1997) have reported on IS outsourcing strategies for the affiliated firms of the Korean conglomerate groups which possess their own IS subsidiaries. IS divisions have been formed by aggregating the IS departments of the group firms. IS division is a separate corporation wholly owned by parent group. It was recommended that to identify the best outsourcing strategy for an affiliated firm, due emphasis should be placed on organization's information intensity and group influence.

Fowler and Jeffs (1998) examined the issue of outsourcing information services through the framework of case study based research located in a major UK company. Qualitative outcomes available from the research process indicated that the managers believed the projected economic benefits to be one of the key drivers behind the outsourcing agenda.

Hwang and Thorn (1999) have argued that the effect of user involvement on system success is an important topic yet empirical results have been controversial. Results showed that user participation had a moderate positive correlation with four success measures: system quality, use, user satisfaction, and organizational impact. The correlation between user participation and individual impact was minimum. User involvement generally had a larger correlation with system success than did user participation. Overall, the findings indicated that both user involvement and user participation are beneficial, but the magnitude of these benefits depends much on how involvement and its effect are defined.

Sarker and Lee (1999) studied causes for the failure of Business Process Reengineering (BPR) initiative in a US telecommunication company. They emphasized that major problems faced during redesigning of business processes included lack of detailed knowledge about functional areas, hidden agendas of top management, lack of knowledge coupled with over reliance on computer based BPR tools and lack of communication. Major problems faced during implementation of redesigned business processes included difficulty in creating an atmosphere of open communication, uncoordinated HR and IT strategies and discontinuities in the leadership. From the study, three fundamental issues were identified that had a great influence on the process and outcome of the failure encountered, *i.e.*, top management leadership, communication and IT knowledge and management.

Domberger *et al.* (2000) studied that outsourcing for IT services has been increasing both in public and private sectors. The study covering 48 contracts for IT support and maintenance made use of regression model for modeling the price, performance and contract characteristics relevant to IT outsourcing. Although the results did not quantitatively indicate significant price-performance trade off but suggest that first time contracts were more expensive than repeat contracts.

Bacon and Fitzgerald (2001) proposed a systematic framework for the field of information systems. According to the authors, the average managers and executives have difficulty in obtaining an integrated and holistic view of the information systems. This difficulty leads to the lack of alignment between IS and the strategic aims of the enterprise.

Barthelemy (2001) argued that IT functions are outsourced to vendors for reducing costs and improving performance. Author has indicated hidden costs involving outsourcing that may eat out advantage available from the stated benefits. Hidden costs include cost on vendor search and contracting, costs of transitioning of in-house activities to a vendor, cost of monitoring the vendor performance and bargaining with IT vendors and cost of transitioning of outsourced activities in the business enterprise from vendor. Extent of hidden costs of outsourcing may act as a major determinant in success and failure of IT projects.

Kanungo *et al.* (2001) emphasized that IT strategies are related to organization culture. Three dimensions of organization culture were assessed namely: Innovative, supportive and bureaucratic. Data collected on 72 public sector organizations showed statistically significant findings that innovative element of public sector units organizational culture is associated with a delineable IT strategy.

Ranganathan and Dhaliwal (2001) argued that BPR when properly done with effective use of information technology can produce significant gains in performance. All that the firms need to do is to alter their processes significantly, invest in information technology, and improve overall performance in order to combat the challenges posed by competitive environment. BPR programs may be undertaken for a variety of reasons and improving operational efficiency is the prime reasons for undertaking them. Next most important motive for initiating BPR exercise is to improve customer service. There are

four key players in any BPR effort: top management, functional executives, IS executives and external consultant. Top management must initiate and support BPR efforts, IS executives need to coordinate the entire program, functional executives need to play support role and external consultants help to facilitate and support BPR efforts. Problems in BPR efforts are lack of champion, strategic vision, difficulty in methodology, lack of top management support and inadequate human and financial resources *etc.*

Somers and Nelson (2001) have tried to identify the impact of Critical Success Factors (CSFs) across the stages of Enterprise Resource Planning implementations. The study was based on survey of 86 organizations that had completed or were in process of completing an ERP implementation. The authors have identified a comprehensive list of twenty two CSFs associated with system implementation derived through a process that involved identification and synthesis of those critical requirements for implementation that have been recommended by practitioners and academicians through an extensive review of literature.

Pan and Flynn (2003) examined the role organizational politics plays in decisions leading to the abandonment of IS projects. Development of IS projects has been viewed as a highly political process. In this political process stakeholders may be more concerned about furthering their self-interests than about contributing to the overall success of the project.

Attaran (2004) explored the relationship between IT and BPR. BPR and IT have the potential to create more flexible, team-oriented, coordinative, and communication-based work capability. Many innovative IT applications stem from a combination of breakthrough ideas and from modifying the ideas that have succeeded or failed in other companies. The barriers to effective implementation of BPR were misunderstanding of the concept, misapplication of the term, lack of proper strategy, unrealistic objectives, management failure to change and failing to recognize the importance of people. It is argued that those aspiring to do BPR must begin to apply the capabilities of information technology.

Aubert *et al.* (2004) proposed and tested an explanatory model of IT outsourcing behavior. Relying on transaction costs and incomplete contracts theories, the model hypothesizes that characteristics of IT operation activities, namely, asset specificity,

uncertainty, business skills, and technical skills required to perform the activities will influence the level of their outsourcing. Results indicated that uncertainty is the major deterrent to outsourcing, while the level of technical skills is the most important reason to outsource. Business skills did not seem to play a significant role. Finally, asset specificity, which is always presented as a constraint to outsourcing, showed inconsistent effects.

Citing literature in the field of IS, Avison *et al.* (2004) suggested that firms cannot be competitive if their business and IT strategies are not aligned. Achieving strategic alignment continues to be the major concern of business executives. Authors attempted to validate Strategic Alignment Model (SAM) in a financial services firm. Results from the study revealed that SAM was having conceptual and practical value.

Feld and Stoddard (2004) argued that making IT work in the organization has little to do with technology itself and IT applications normally fail because of lack of communication between business people and technology people. Further, wide spread vertically oriented data silos need to be replaced with horizontally oriented architecture design for effective use of IT. Researchers have emphasized on three principles for making IT work for the organization including a long-term IT renewal plan linked to corporate strategy, a simplified and unifying corporate technology platform and a highly functional and performance oriented IT organization. Integration holds the key as heterogeneous hardware and software systems always lead to rampant costs. For ensuring cost effective applications of IT in the organization emphasis should be on professional and sophisticated IT leadership.

Gupta and Sanjay (2004) carried out a survey of business executives and IS staff of select IT savvy organizations. It was revealed by the study that rapid changes and developments in the IT domain have created new leaders in market place. These developments are being leveraged in the fields of supply chain, inventory control and business intelligence applications. Information systems devised by such companies are the basis of differentiation.

Liang and Xue (2004) conducted a study from vendor's perspective and analyzed what can be done to address contextual issues relating to ERP implementation. Findings of the study revealed three strategies that could be useful for achieving fit between ERP systems

and adopting organizations. First, ERP systems need to be localized to reflect the local management features. Second, ERP systems should be customizable at a variety of levels. Finally, BPR should be carried out in an incremental manner, taking the dialectic of organizational learning into account. A significant contention is that IS researchers and practitioners should consider companies' stages of growth as a contextual factor when conducting ERP research or implementing ERP systems.

Organizational context is crucial to understand the nature of Enterprise Application Integration (EAI). Sharif *et al.* (2004) argued that the needs and requirements of traditional business structures are quite different from wholly virtual organizations or organizations based on notions such as extended supply chain. Keeping in view the above-mentioned argument it was further stated that evaluation of EAI projects is context dependent. EAI is a backroom technology, which is often perceived primarily a productivity tool for IS professionals. Measurement techniques need to capture benefits, dis-benefits and side effects. There is a need to address the long-term impact of EAI practices on the culture of the organization as well.

Organizations often appear to be unaware of fundamental differences that exist between their organizational context and that which is assumed by ERP package developers. This has undermined expected benefits from ERP implementations, and in extreme cases of package-organizational misalignment, has led to project and even organizational failure. Soh and Sia (2004) have explained package-organizational misalignments as the result of differences between the structures embedded in the package and those embedded in the organization. These differences reflect the different institutional context of the package developers and implementing organization. Some organizational structures are imposed while others are voluntarily adopted. The organization has less control in the case of imposed structures and misalignments associated with imposed structures are therefore more likely to be resolved through package customization. The project management is critical to ERP success, its effectiveness requires its clear understanding of the extent and nature of package-organizational misalignment, so that appropriate resolutions approaches can be pursued and needed resources obtained.

Somers and Nelson (2004) have identified key players and activities across the ERP project life cycle. Implementation of ERP process and the probability of

conversion success included factors as support and commitment of senior management, redesign of business processes to fit the software, investment in user training, avoidance of customization, use of business analysts and consultants with both business knowledge and technology knowledge *etc.* The study highlights an important aspect that success factors importance changes with stage of project life cycle like user training is essential in acceptance stage, change management and education are must in business reengineering during initiation stage,

Cullen *et al.* (2005) argued that pervasive adoption of IT has made Information Technology Outsourcing (ITO) a growing multi billion dollar industry. ITO configuration is a high level description of the set of structural choices made in crafting IT arrangements. An organization's configuration is not static, it changes over time. It is important as different configurations require different lifestyle planning and management approaches. Authors have proposed seven configurations attributes, *i.e.*, scope grouping, supplier grouping, financial scale, pricing, duration, resource ownership, and commercial relationship as key descriptors of organization's ITO configuration.

In their study Kim *et al.* (2005) found that most of critical impediments in ERP implementation process are related to inadequate support from functional units and coordination among functional units, the project management related to business process change, and change management related to resistance of users. Less successful companies have problems that stem from issue sin the early stages of project initiation from organizational support and technical knowledge insufficiency. Relatively more successful organizations encounter most of their problems in managing the project and in having a lack of human resources who can implement large-scale systems.

From the findings of an in-depth case study of implementing ERP in long-established multinational company, Nandhakumar *et al.* (2005) stated that it is necessary to understand large scale ERP implementation in the organizational context. ERP implementation could change infrastructure and operating practices of an organization so implication of ERP implementation could be fundamentally wider than of any traditional transaction. By taking account of managers' intentions, technological affordance and power context we can explain the triggers of technology drift associated with ERP system as well as consequences of their drifts.

Pati and Desai (2005) argued that outsourcing of IT is emerging as a potent business strategy and it will grow unabated in the foreseeable future. However, many organizations plunge into this outsourcing without understanding the strategic implications of such an arrangement resulting in failure. The organizations that plan well before opting for outsourcing reap the benefits in terms of cost savings, improved rate of Returns on Investment (ROI) and improved access to best practices in IT resources. The outsourcing decision of IT should be considered strategic as the relationship and the knowledge gained during the engagement can be translated into tangible and intangible business values for the organization. The key to long term success is the mutually beneficial partnership of the client and the provider. An organization should match its internal capability against an IT service opportunity and the potential strategic business value that can be obtained from the engagement to make the decision whether the service is worthy of outsourcing or not. For example, a low level of internal capability for a discrete IT service engagement that has a low business value for an organization leads to outsourcing and a high level of internal capability for an end-to-end solution engagement that has a high strategic business value for the organization leads to insourcing. An organization should also identify the conditions for strategically focused relationship management during the post-engagement phase of the outsourcing.

Tarafdar and Vaidya (2005) in their case study discussed the challenges in the adoption and implementation of IT in two public sector enterprises in India. It was found that despite of similarities in the scale of operations and general culture, there was a significant difference in the IT adoption process and outcomes of the two organizations. Organizational factors like top management commitment, unions, middle management participation, capabilities of IS professionals and specific aspects of organization culture resulted in different scenarios in the similar organizations. While undertaking IT modernization public sector units and other government-aided agencies must consider the cultural aspects involved in the successful implementation of IT adoption.

Verville and Bernadas (2005) argued that single critical success factor can not make ERP acquisition successful; rather a combination of several critical factors will result in a successful outcome. Critical factors related to the acquisition as process include planned and structured process, rigour of process, definition of all requirements, establishment of

selection and evaluation criteria and accurate information. Factors related to people within this process include clear and unambiguous authority, careful selection of the acquisition team members, partnership approach, user participation and user buy-in.

Ward *et al.* (2005) argued that it is imperative for organizations embarking on Enterprise wide System (ES) projects to be aware of the success and failure factors, and understand how to address them. The organizational issues are more critical than technical considerations, since the benefits are typically realized through extensive changes to business practices and decision making. The organizational issues refer to the effects of organization culture, structure, governance, communication and conflict between stakeholder groups. For successful implementation of the project three types of negotiation approaches can be adopted by ES project team. These are: first, power-based in which financial, political and other sources of power are used to coerce stakeholders; second, interest-based, in which the needs and concerns of all stakeholders are considered and third, rights-based in which divergent interests are dealt with in a contractual or legal way. An ES project team's ability to select and use an appropriate negotiation strategy when managing potential stakeholder conflict would be helpful in resolving organizational issues during ES implementation.

Duh *et al.* (2006) explored the association among strategy, the extent of IT applications to planning and control functions, and firm performance. Results indicated that strategy significantly influenced the extent of IT applications for planning and control. In turn, the extent of IT applications had a significant direct effect on firm performance. Direct effect of strategy on firm performance was found to be insignificant. The relationship between strategy and the extent of IT applications, and between the latter and firm performance were both stronger when the level of impediments was low.

Gonzalez *et al.* (2006) emphasized that outsourcing has become a basic strategy of the IS field and over the past few years the use of outsourcing in IT has increased. In the field of outsourcing new topics have emerged such as influence of outsourcing on the computer staff and threat to the jobs of Western computer specialists.

According to Gonzalez *et al.* (2006) IS outsourcing is a constantly growing phenomenon that evolves through the provision of new services and is spreading to different geographical regions. Large Spanish firms allocate few resources to their IS departments,

in terms of both staff numbers and budget. Results from Delphi method used in the study also pointed that experts were in agreement that the position and hierarchical dependence of the IS manager, who reports to finance and administration areas in one third of large firms is not correct. Main goal sought through outsourcing was IT improvement rather than cost control. It was argued that resorting to outsourcing is often the only way to be up to date.

Karyda and Mitrou (2006) have argued that apart from reaping financial benefits, by outsourcing IS/IT functions, organizations aim to have improved access to specialized knowledge and best practices, receive better quality services, have increased business continuity capability in case of internal incidents and achieve flexibility with regard to technology. The basic argument for IS/IT security outsourcing is that security issues are handled by experts, allowing companies to focus on their core competencies. On the other hand, an important issue that discourages companies from outsourcing their security functions is the fear of losing control over their systems. Organization need to take into account not only technical, but also organizational and legal issues for formulating their strategy with regard to IS/IT security outsourcing.

Rondeau *et al.* (2006) argued that firms with high levels of organizational involvement in IS related activities have higher levels of IS management effectiveness. Singla and Goyal (2006) argued that the majority of ERP systems proved to be a failure either in the design or during implementation. For ensuring overall success, it is important to have knowledge about interdependencies of business processes, relational databases, and process reengineering.

Singla and Goyal (2006) argued that the majority of ERP systems proved to be a failure either in the design or during implementation. For ensuring overall success, it is important to have knowledge about interdependencies of business processes, relational databases, and process reengineering.

Soja (2006) examined the ERP implementation process using the proposed success factors model. The findings suggested that the factors' influence on the implementation success should be examined taking into account the division of the projects into groups regarding the project duration, the scope being implemented and the size of an enterprise. Factors with the greatest influence on implementation success included team involvement, system reliability, team composition, detailed schedule, IT infrastructure and top management support.

Tarafdar and Vaidya (2006) argued that IS assimilation is the extent to which a system or technology becomes diffused in organizational processes, from adoption to general deployment. It is determined by the extent to which an information system is used in different

functions and how effectively it enables the conduct of activities associated with them. The given study analyses organizational and strategic imperatives that have influenced IS assimilation and evolution of IS application portfolio in Indian firms. It identifies three categories of organizations with respect to IS assimilation and describes strategic and organizational factors characteristic of each group. It traces the evolution of IS application portfolio in each of the studied firms and analyses accompanying changes in organizational and strategic factors. Assimilation depends on the actions of managers in a firm. The imperatives that influence IS assimilation are those pertaining to strategic and organizational context. Strategic imperatives include factors which impact IS assimilation through their influence on the organizations business strategy like the factors related to external environment, characteristics of industry, competition *etc.* Organizational imperatives describe management related factors which influence IS assimilation.

As information technology (IT) outsourcing continues to grow and impact the business environment, the termination of inter-organizational relationships is clearly a major issue for practitioners, managers, and researchers. Whitten and Wakefield (2006) stated that switching costs are important factors in decisions to terminate contracts; however, the measurement of switching costs and their role in IT outsourcing discontinuance remains unclear. Switching cost construct was evaluated as a higher-order factor comprising of specific first-order dimensions in order to advance theory development and testing related to IT outsourcing. When measured at a higher level, the construct had important implications for how switching costs are defined, operationalized, and interpreted.

Zu *et al.* (2006) used case study method for examining Inter-Organizational information Systems (IOS) of Cisco and Xiao Tong in China. The results confirmed the organizational benefits of IOS such as increased co-ordination, shorter sales or production turn about times, greater monitoring capability and elimination of redundant tasks. Seven critical success factors identified for IOS were intensive simulation, shared vision, cross organizational implementation team, high integration with internal information systems, inter-organizational business process reengineering, advanced legacy information systems and infrastructure and shared industry standards.

Chen *et al.* (2007) have defined key issues in IS management as the set of main challenges facing IS managers over the next 3-5 years. Out of twelve key issues investigated by the researchers support of and acquaintance with IT of high level managers; technology

competence of staff in IS departments and internal managerial; and organizational level of IS departments were the top three issues influencing information systems management in China. Goyal (2007) conducted a study to analyze the IS planning practices in Indian public sector enterprises. The study was conducted on two enterprises, namely, Hindustan Machine Tools Ltd (HMT) and Punjab Communications Limited. Results indicated that planning for acquiring new information system or for developing new information system is not given a high priority. This shows that planning for new information system, in general in the selected public sector enterprises has been a neglected area, which is a weak IS practice. The study showed that the planning of IS for other departments, the department management as well as the department staff plays a supportive role.

Kearns and Sabherwal (2007) argued that senior managers continue to be concerned with factors influencing the business effect of IT. Results from their study indicate that organizational emphasis on knowledge management and centralization of IT decisions affect top managers' knowledge of IT, which facilitates business managers' participation in strategic IT planning and IT managers' participation in business planning. Quality of IT project planning and implementation problems in IT projects mediate the relationship between business-IT strategic alignment and business effect of IT. Findings from the study highlight the importance of considering the planning and implementation of IT projects for examining the effects of business-IT strategic alignment.

Nevo *et al.* (2007) opined that IT has become indistinguishable part of business today. IT outsourcing is major concern for business organizations through the use of external IT consultants which varies with different companies. With increasing internal IT strength, effectiveness of external IT consultants decreases as there may be conflicts between internal and external IT capabilities. Business organization firms should evaluate their internal IT capabilities before making a decision to hire external IT consultants. If the in-house IT staff is capable of implementing the IT solution on its own and if the potential for conflict is high then firm should rely solely on internal IT capabilities. But if

these are weak, then taking into account cost factor, they should either adopt for outsourcing or try to increase their internal IT capabilities.

ERP systems allow seamless integration of information flows and business processes across functional areas within a company help to achieve operating efficiency and generate automated workflows according to business rules. The relationship between business process change and successful ERP adoption is

symbiotic: the benefit of ERP adoption often results in business change. Law and Ngai (2007) examined the relationships between the success of ERP system adoption, extent of Business Process Improvement (BPI), and organizational performance and investigated the associations between the outcomes of these initiatives and such organizational factors as strategic intent, senior management support, and the status of the IT function within a company. Results from the study reinforced the long-held assumption that organization-level benefits, BPI, and ERP success were closely related; and that these relationships were subject to the influence of the organizational variables.

Park *et al.* (2007) made an attempt to examine the effect of absorptive capacity of the user on their use of ERP in the Korean context. Three component used for the study were understanding, assimilating and applying ERP knowledge. It was found that absorptive capacities for understanding, assimilating and applying knowledge influence the performance of the ERP. The user's ability to understand ERP knowledge was found to influence its performance by their assimilating and applying the knowledge .It was also found that organization support moderated the relationship between their absorptive capacity and performance.

Ramayah *et al.* (2007) found top management involvement, business plans and vision as major critical factors for smooth introduction and successful implementation of ERP systems. Organizational resistance was found to moderate the relationship between critical factors and user satisfaction.

Wybo (2007) argued that the current IS environment is largely focused on purchasing and configuring pre-existing functionality rather than on specifying and building new functionality. IS sales cycle serves as the origin for many of contextual factors that are a key part of implementation theory. Sales cycle can be defined as beginning of first contract with the vendor and the buyer and ending with the signature of a contract between the parties. Understanding the IT implementation process as both acquisition and deployment activities provides a more coherent perspective on implementation outcomes and processes.

Major themes of IS outsourcing and implementation have been presented in Table 2.1. It can be seen from Table 2.1 that outsourcing trends and reasons for outsourcing have been the major issues of interest in IS outsourcing literature. IS implementation literature largely focuses on role of the stakeholders, change management and importance of IS planning during its implementation.

Table 2.1: Major Themes of Reviews regarding Outsourcing of IS and Implementation of IS

Issue	Study	Contribution
Trends in Outsourcing	Lee and Kim (1997)	Korean conglomerate groups having own IS subsidiaries.
	Domberger <i>et al.</i> (2000)	Increased outsourcing in public and private sectors
	Cullen <i>et al.</i> (2005)	Key descriptors in organization's IT outsourcing
	Wybo (2007)	IS scenario being focused on purchasing and configuring pre-existing functionality
Reasons and Benefits of IS Outsourcing	Fowler and Jeffs (1998)	Projected economic benefits being key drivers behind outsourcing
	Barthelemy (2001)	Reducing costs and improving performance being reason for outsourcing, hidden costs of IT outsourcing
	Pati and Desai (2005)	IT outsourcing as well planned business strategy
	Karyda and Mitrou (2006)	Access to specialized knowledge, best practices and better quality services
	Whitten and Wakefield (2006)	Switching costs supporting continuance of IT outsourcing
Role of Stakeholders in IS implementation	Abreu and Conrath (1993)	Stakeholders' expectations about the changes play a major role in determining the outcomes of IS introduction
	Hwang and Thorn (1999)	Both user involvement and user participation are beneficial to IS success
	Pan and Flynn (2003)	Development of IS projects as a highly political process
	Feld and Stoddard (2004)	Communication between business people and technology people
	Somers and Nelson (2004)	Identification of key players and activities successful implementation of IS
	Verville and Bernadas (2005)	Combination of several factors, related to acquisition process and people, responsible for successful ERP acquisition
	Nevo <i>et al.</i> (2007)	Varied use of external IT consultants
Change Management and IS implementation	Sarker and Lee (1999)	Causes for the failure of Business Process Reengineering
	Ranganathan and Dhaliwal (2001)	BPR along with effective use of information technology can produce significant gains in performance
	Attaran (2004)	Applications of IT capabilities related to BPR
	Liang and Xue (2004)	Carrying out BPR in incremental manner
	Nandhakumar <i>et al.</i> (2005)	ERP implementation could change infrastructure and operating practices of an organization
	Law and Ngai (2007)	Close relation between Business Process Improvement and ERP success
Importance of Planning for IS Implementation	Avison <i>et al.</i> (2004)	Alignment of business and IT strategies must for competitiveness
	Soh and Sia (2004)	Package-organizational misalignments undermine expected benefits from ERP implementation
	Duh <i>et al.</i> (2006)	Significant influence of strategy on the extent of IT applications for planning and control
	Goyal (2007)	Neglect of planning for new IS as a weak IS practice
	Kearns and Sabherwal (2007)	Importance of considering the planning and implementation of IT projects for examining the effects of business-IT strategic alignment.

2.2 USE AND BENEFITS DERIVED FROM INFORMATION SYSTEMS

Alter (1976) emphasized that advances in computer-based information technology in recent years have led to a wide variety of systems that managers are now using to make and implement decisions. Usually, these systems have been developed from the scratch for specific purposes and differ significantly from standard electronic data processing systems. Managers have little say in development of these Decision Support Systems and non-managers who develop these systems have limited view of how they can be used. Difference between success and failure of these systems depends upon the extent to which managers can use the systems to increase their effectiveness within the organization.

Rockart and Treacy (1982) studied top level managers for use of IS and reported that these executives were obtaining valuable support for purpose of planning and control from IS. Alloway and Quillard (1983) conducted a study on managerial use of IS. According to the study, managers indicated that usually computer systems supported lower level business functions and asked for flexible inquiry and analysis systems.

McFarlan (1984) argued that computer based technology is moving from strictly supporting role in the back office to offering new competitive opportunities. Companies can use this technology to build a barrier to entry, to build in switching costs and even to completely change the basis of competition. It is important for executives to assess where it fits in their companies, since in some cases it appropriately plays a support role and can add only modest value, while in others; it is at the core of their competitive survival.

Cooper and Kaplan (1988) argued that companies selling multiple products are making important decisions about pricing, product mix and process technology based on distorted cost information. Normally, alternative information rarely exists to alert managers that product costs are badly flawed. With plummeting costs of information technology it is not justifiable to stick to conventional approaches. Companies should try to move to new approaches such as Activity Based Costing with help of information technology.

Adam and Murphy (1995) studied the information practices of executives. The results showed that executives use a combination of communication flows and information flows in a proportion which varies depending upon the context of different activities. The study revealed that executives initiated information and communication flows of a different

nature depending upon the role they play and the level of those with whom they deal within the organization. It was suggested that very specific approaches were needed when identifying executives' needs in terms of developing systems aimed at supporting top managers' strategic activities.

According to a study made by Gill (1996), benefits of using an expert system include increase in decision quality, consistency and increased speed of decision making. The task change, in form of a user's sense of control over a task or making a task less routine, is expected to increase the usage of an expert system.

Gupta (1996) revealed that the existing MIS at the national level is affected by inadequate and unrelated sources of information with large delays, non-smooth flows due to confidentiality constraints and isolated efforts of computerization. Results from the study established the prime need for long-term, well directed, and integrated efforts in order to streamline the decision making and administrative functions in various ministries.

Satya and Mensah (1997) suggested a strategy for obtaining insight on IT productivity. Instead of measuring the causes and effects, one should focus on companies that have been relatively more successful in order to determine if the differences in results are associated with special IS variables. The significant IS variables were 'the Chief Information Officer's (CIO's) years in the position (CIOYR)', 'the proportion of software resources spent on the development of new applications (NEWD)', and 'the proportion of software resources spent on client server applications (CSAP)'. The relationships of these factors to IS productivity were found to be negative for the first two factors and positive for the third. In the manufacturing firms, a lower CIO reporting level was reported to be associated with higher productivity but in the non manufacturing firms, a higher CIO reporting level was associated with higher productivity. Companies in the high productivity group were spending proportionately lower amounts on the development of new applications software (in-house development), while they were spending proportionately more on client server applications. They may, therefore, be using outsourcing to a greater extent by making purchases from well-established developers of client server applications; this may be a risk reducing and cost saving factor.

Walstrom and Wilson (1997) conducted a study on the use of Executive Information Systems (EIS). The study showed that EIS users most often used their EIS to obtain

information previously provided in a written report, predetermined and preformatted reports. EIS was used the least for computer conferencing and to access network television.

Choe (1998) suggested that under high task uncertainty, aggregated and timely information with high user participation was positively associated with increased Management Accounting Information Systems. However, when the task uncertainty was low, user participation made no impact on the relation between performance and information characteristics.

Ferratt *et al.* (1988) studied computer use by production managers and concluded that in the opinion of the respondents a strong support was available from IS for performing managerial activities.

Gelderman (1998) argued that it is difficult to assess the contribution of IS to performance in real world situation, a large portion of the costs and benefits will be qualitative or intangible. Two alternative success measures gained acceptance; usage and user satisfaction. Both are supposed to be proxies for the contribution to organizational performance. Users are able to assess the value of the IS and will use it if they conclude that the benefits will outweigh the costs. Application of usage as a success will be used if managers feel that it facilitates their own goal. The low and insignificant correlations between usage measures and performance measures were obtained from the study.

Mirani and Lederer (1998) studied 178 IS projects and developed an instrument to measure the organizational benefits of IS projects. The basis for this instrument was a published framework suggesting three categories of such benefits namely strategic, informational and transactional. The analysis not only culminated in the validation of these three benefits but also led to refinement of these benefits into sub dimensions.

Rawstorne *et al.* (1998) discussed an integrated model of information systems use in mandatory environment. They argued that IS adoption ranges between two poles, comprised at one end by voluntary adoption and at the other end by mandatory adoption. Voluntary adoption is there, when the end user has freedom to decide whether or not to utilize the IS and mandatory adoption involves when the end user is forced by the organization through reward inducements or threats of punishments or a combination of both.

Winter *et al.* (1998) suggested that attitudes towards computers did predict computer use. Attitudes towards computers are an appropriate focus for organizations attempting to increase the number of hours that their employees use their computers. Organizations attempting to increase the extent to which workers' jobs are computerized should focus on improving attitudes towards computers for those workers who have freedom of choice in using their computers and those with the knowledge to use them. Improving workers' computer literacy and control may enhance the relationship between attitudes and computer use.

Kearns and Lederer (1999) studied the influence of environmental uncertainty on the strategic use of information systems. They emphasized that the role of the CEO in strategic information systems planning and the CIO in business planning may become more important under environmental uncertainty especially for the firms that are highly dependent upon information technology.

Martinsons *et al.* (1999) argued that balanced scorecard has emerged as a decision support tool at the strategic management level. Researchers have proposed a balanced IS scorecard. The balanced IS scorecard is based on four perspectives namely, user orientation perspective, internal processes perspective, business value perspective and future readiness perspective.

Palvia and Chawla (1999) stated that although the use of IT in small business has increased, still pales in comparison with IT applications in large and medium sized business organizations. Estimates of small business use of computers over the years have been ranged from below 30 percent to about 80 percent, depending on the location, size, and nature of the business. While the trend appears to indicate an increase in the use of IT, this is mainly for operational and administrative tasks rather than for strategic or decision making purpose.

Lin and Shao (2000) emphasized that through participation, users of IS can interact with system designers in the stages of planning, analysis, design, testing, and implementation and, hence, aid in many aspects of the system development process. User participation is also believed to increase user acceptance of the system with a more realistic expectation about system capabilities. Empirical results from the study corroborated the positive link between user participation and user satisfaction and provide evidence on the interplay

between user attitudes and user involvement. Results showed that system complexity has a significant effect on user participation.

Poston and Grabski (2000) studied the impact of ERP systems on firm performance in 50 firms. Reviews suggested that the firms expect a number of benefits from ERP systems, *i.e.*, reduced asset bases and costs, reduced financial cycles, enhanced decision support, increased customer satisfaction through integration and consistency, globally integrated information access across the enterprise and supply chain. Results indicated that ERP implementation is associated with a significant increase in Selling and General and Administration cost to revenue ratio (SG&A/Revenue) after one year of implementation over the year prior to implementation.

Vlahos *et al.* (2000) surveyed a sample of German managers to investigate the amount of Information Technology, these managers used. The study also investigated perceived value and satisfaction of these managers with respect to their existing Computer Based Information Systems (IS) in providing helpful information for making successful and effective decisions. The findings from the survey showed that German managers used IT rather heavily, *i.e.*, approximately 10 hours per week. It was also found that first line managers were the heaviest users of IT and perceived the greatest value of IS for decision making. Top-level managers were the lightest users of IT but perceived greater value of IS than middle managers. In case of functional areas, managers in information systems and accounting/ finance were the heaviest users of IT and perceived the greatest value of IS. A significant correlation was found between the amount of use of IT and the perceived value of IS.

Andersen and Segars (2001) emphasized that investment in new information technology remains a central strategic issue as firms try to gain competitive advantage in the increasingly dynamics environment, even though the impact on performance is not fully understood. Direct and indirect performance effects of IT in the textile and apparel industry were investigated. The results indicated that performance effects of IT can accrue from an ability to enhance communication capabilities that make a decentralized structure more effective. The indirect performance effect of IT emerges from inducement of high performing decentralization that enables individuals to take effective action.

Chang (2002) introduced a model of computerization of manufacturing system by drawing on the practical experience of senior managers of manufacturing and information management in Taiwan and U.K. Six important elements of Information Systems Support for Manufacturing (ISSM) integration and implementation were found; these were nature of manufacturing system, ISSM and related software subsystem, barrier to ISSM, facilitators to ISSM, measured benefits from ISSM investment and level of ISSM integration. The study identified a number of barriers such as software inflexibility, poorly defined operating process, lack of system design and lack of provision for real user demand. Perceived benefits included improvement in material handling, order winning capability, meeting delivery dates reduced cost, lower inventory *etc.*

Kumar (2002) has argued that organizations are making large investments in IT projects. Many of these are risky and considered run away because of not meeting original expectations of cost, time and benefits. Effective management of risks in IT projects is extremely important. IT project managers typically manage risk by identifying risks and formulating risk management strategies. These strategies include risk reduction as well as risk mitigation strategies.

Salmeron (2002) has portrayed the situation of EIS in large Spanish businesses and some interesting elements in the evolution of Spanish EIS. In a competitive environment, it is no longer enough for the managers to make the right choices, but they must also make and implement them as quickly as possible. The number of executives that directly use EIS has increased. This phenomenon is related to two things: first, the realization of the importance of the information systems by Spanish executives and second the emergence of new generations of managers in the Spanish businesses with greater technological culture.

Tagliavini *et al.* (2002) explored the use of ERP systems by Small and Medium Enterprises (SMEs) in Italy. Two major variables selected for association with use of ERP were level of business complexity and the extent of organizational change being planned by the company. The results showed that the business complexity and the extent of desired organizational change are directly related to the use of ERP systems.

Gefen and Ridings (2003) examined the issue of IT acceptance. According to them, users and IT personnel belong to different organizational units with different objectives and

values. This difference often gives rise to a perceived boundary between the two units. Perceived boundary leads to reducing the degree to which users accept the installation of new IT.

Legris *et al.* (2003) suggested that enterprises invest in information system for many reasons; pressure to cut cost, pressure to produce more without increasing costs, and simply to improve the quality of services or products in order to stay in business. It was found that Technology Acceptance Model (TAM) is a useful model that examines the mediating role of perceived ease of use and perceived usefulness in their relation between system characteristics and the probability of system use.

Walters *et al.* (2003) stated that Executive Information Systems (EIS) provide executives with easy access to internal and external information to top management for the environmental scanning. Environmental scanning is an essential activity undertaken by top executives in order to be effective in steering the organization in the changing environment. A survey of CEOs for small manufacturing firms indicated that internal information is just as important in analysis of new situations as is the external information. Additionally, the CEOs place no particular order on access to the information. EIS should be designed to allow for access to all categories of information in an order selected by the executive and provide important internal information for making strategic decisions.

Behesti (2004) has argued that the rapid growth of technological innovations along with the fusion of information technology and computer networks are drastically changing the way companies compete. Many business enterprises are making strategic commitment to technology for the purpose of gaining and sustaining competitive advantage in their industry via increased productivity, improved profitability, and value for customer. Results of the study showed that small businesses were utilizing internet more than their larger counterparts. This is due to fewer obstacles associated with systems integration and more flexibility to implement change. Business owners of SMEs must regard IT as a strategic resource that can be used to strengthen the competitive position of the firm as opposed to a tool for an automation of existing processes, computerization of financial and accounting practices, and improving productivity and efficiency.

Choo (2005) opined that information failures can lead to organizational disasters and emphasized the need to become vigilant for avoiding such situations. For guarding against information failures in the organization, suggestions have been made both at the individual level as well as at organizational level. At individual level people in the organizations should be aware of biases in how information is used to make judgments. At the organizational level companies need to cultivate an information culture that can recognize and respond to unexpected warning signals and in addition, enables the organization to contain or recover from incipient errors.

Ranganathan and Kannabiran (2004) have argued that several Indian organizations have turned to IS for improving their competitiveness and overall business performance. For achieving the same it is necessary to design effective IS functions and sound IS management processes.

Kearns and Lederer (2004) tested the extent to which contextual factors impact business dependence on IT and Strategic Information Systems Practices (SISP). These practices were IT participation in business planning and the use of IT for competitive advantage. The study found a positive and significant impact of contextual factors on business dependence on IT and the two SISP practices and between these factors and the use of IT for competitive advantage. Results from the study revealed significant differences between industry types and environment uncertainties.

Wu *et al.* (2004) provided an empirical insight to explain the perceived importance of managerial activities and the associated managerial skills for each level of IS management. The perceived importance of IS management activities were viewed in significantly different ways by different levels of management and the degree of importance for these activities was not significantly different in different types of organizations.

Bokhari (2005) argued that system usage and user satisfaction are widely accepted and used surrogate measure of IS success. Past findings were critically examined and existing inconsistencies were resolved. On the basis of this study, it was concluded that there was a significant positive relationship between 'system usage' and 'user satisfaction'.

Chou *et al.* (2005) proposed a Business Intelligence (BI) and ERP integrated framework for adding value to enterprise systems. ERP systems contribute on basis of their ability to

integrate and manage enterprise-wide transactional data. Companies that were unable to justify ROI for ERP implementation are now implementing BI software since it enhances the utilization of the enterprise data. ERP systems are extremely complex and it is difficult to extract data for BI in a way that is independent of the extract facilities supported by the ERP system. ERP systems streamline enterprise transactional data. BI systems add intelligence into their ERP data. Together, ERP and BI can greatly improve the IT performance and decision-making capability inside the organization.

Ezingear *et al.* (2005) argued that aspects such as quality and trustworthiness of information are becoming key business issues. Effective Information Assurance (IA) is the key to reliable decision-making, customer trust, business continuity, and good governance in all sectors of industry and public service. Yet making a business case for IA investments can be difficult because of the scope of their broad potential benefits.

Gefen and Ragowsky (2005) examined the association between the business characteristics of manufacturing firms and their perceived benefits from ERP system investments. The perceived ERP benefits were measured at two levels, *i.e.*, at enterprise level and at specific IT module level. It was concluded that an ERP should be installed to address specific needs and to fit in with in the organization's business characteristics. The benefits derived from an ERP system may be different for different modules. It was also found that the perceived value for ERP investments was consistently better explained at the specific IT module level.

Moller (2005) proposed a conceptual framework for extended enterprise resource planning (ERP II). The proposed framework consists of four components namely, core, central, corporate and collaborative. Core components include integrated database and application framework. Central components include ERP and Business Process Management (BPM). Corporate components included Supply Chain Management, Customer Relationship Management, Supplier Relationship Management, Product Lifecycle Management, Employee Lifecycle Management and Corporate Performance Management. Collaborative components consisted of B2C (Business to Consumer, B2B (Business to Business), B2E (Business to Employee) and EAI. It was argued that inter-organizational integration is crucial to reaping the benefits of ERP II.

Tyrvaainen *et al.* (2005) discussed that verbal and paper communication is still prevalent in the business organizations along with digital communication. Internal digitization was found to be better correlated with outbound communication as compared to inbound communication. Preference for patterns used for communication affects media selection in the organization as well as emergence of new business information systems.

Cuellar *et al.* (2006) have proposed four dimensions to access the use of the system, namely, automation level, extent, frequency and thoroughness. Automation level signifies amount of process encoded in the system, extent denotes amount of use of system features, while thoroughness means the depth of use of system features. It was concluded that automation applies to the work system globally; the remaining three dimensions apply locally at the participant level.

Jain and Kanungo (2006) emphasized that the marginal contribution of unit change in the degree of IS use to IS-enabled performance improvement is enhanced considerably with improvement in the way IS are used. Results of their study showed that IS use and nature of IS use are both positively related with IS-enabled performance improvement and there is a complementary relationship between IS use and nature of IS use in their joint effect on IS-enabled performance improvement.

Subramaniam and Iyigunor (2006) have discussed the use of information systems in the area of supply chain management. IT investments can be leveraged to establish critical and timely strategies for improving product offering to customers. Using case studies, authors have spelt out variety of IT/IS applications that can be used for superior performance.

Sayed (2006) argued that ERP represents an opportunity for accountants to assert their expertise and to prove new identities for themselves by acting as the spokesperson of technology. Findings of the study pointed that there was no dilution of expertise in relation to ICTs rather accountants mobilize the advent of ERP as an occasion where their skills and their accounting knowledge are represented as important for the proper functioning of these technologies.

Spathis (2006) examined the accounting benefits involved in adopting enterprise systems and the underlying causes that motivate their adoption. Results from the study confirmed a number of benefits derived from the application of enterprise systems that focused on

the dimensions such as organization, operations, management and IT infrastructure. Empirical evidence from the study suggested that the impact and changes to accounting information and practices following the adoption of enterprise systems were of a moderate nature. Highly rated perceived benefits from enterprise systems included increased flexibility in information generation, increased integration of applications and improved quality of financial reports.

Stefanou (2006) argued that the emergence of ERP phenomenon in the last decade has brought into attention the transactional information systems and their importance for the modern, networked and web-based enterprise. ERP systems are actually based on the financial subsystem or module which in essence holds together the rest implemented subsystems.

IT competence in information and knowledge management, project management, collaboration and communication, and business involvement are likely to improve an organization's ability to innovate. Gordon and Tarafdar (2007) argued that IT and information systems could stifle creativity and innovation by standardizing, automating, and institutionalizing the existing processes and workflow. Organizations that want to be innovative should cultivate the identified IT competences.

Hussain *et al.* (2007) argued that increasing pressure to support strategic objectives has led to changes in both job content and expectations of Human Resource (HR) professionals. Increased use of Human Resource Information Systems (HRIS) allows professionals to achieve improved performance and thus facilitate participation in internal consultancy services. HRIS usage allows HR professional to become a strategic player. With increasing functionality and affordability, HRIS are being used extensively in organizations of all sizes. It has been found that the professional standing of the HR professionals has been enhanced by the specific use of HRIS for strategic partnering. HR professionals both provide value to the organization and improve their own standing in the organization by using HRIS.

Customer Relationship Management (CRM) is an information system that tracks customers' interactions with the firm and allows employees to instantly pull up information about the customers such as past sales, service records, outstanding records and unresolved problem calls. Nguyen (2007) emphasized that competitive advantages that organization could gain from CRM systems include increase in customer loyalty, superior service, superior information gathering, knowledge sharing and organizational learning. Lack of knowledge

and research, lack of project management skills and lack of commitment from the executive management are the major reasons for many organizations failing to implement CRM systems.

O'Brien and Marakas (2007) have classified information systems into operations support systems and management support systems. Operations support systems include Transaction Processing Systems (TPS) and Office Automation Systems (OAS). Management support systems include Management Information Systems (MIS), Decision Support Systems (DSS) and Executive Support Systems (ESS). For creation of new knowledge another information system being put to use is Knowledge Work System (KWS).

Oh and Pinsonneault (2007) compared two conceptual (resource centered and contingency based) and two analytical (linear and non linear) approaches that can be used to assess the strategic value of information technology. Results from their study indicated that the resource centered and contingency based approaches provide complementary understanding of the strategic value of IT. Alignment between business strategy and information system strategy on cost reduction was found to have a significant negative association with firm expense. Results from the study also indicated that investments in growth oriented applications were directly and positively related to firm revenue.

Srivardhana and Pawlowski (2007) examined the relationship between ERP systems and innovation from a knowledge-based perspective. The implication of the knowledge-based analysis, presented in the study, is that ERP systems present dialectical contradictions, both enabling and constraining business process innovation. Using a model, the study highlights areas where active management has potential to enhance the capabilities of a firm for sustained innovation of its business processes. Future research directions are also outlined.

Ragowsky and Gefen (2008) concluded that the companies that use ERP system for strategic purposes are likely to have their IT managed by senior management and create strategic barriers with their ERP. Use of IT available to other companies also has a potential to create a competitive advantage. Depending upon organizational operational characteristics, companies using ERP software can gain competitive and strategic advantages.

Table 2.2 presents the major themes of IS use literature. Major issues of IS use include using IS for inculcating efficiency in the organization and using IS for bringing effectiveness in the working of the organization. In context of the present work, apart from these two issues, use of IS for supporting various managerial tasks has been identified as another theme of IS use literature.

Table 2.2: Major Themes of Reviews regarding Use of IS

Issue	Study	Contribution
Using IS for Efficiency	Alloway and Quillard (1983)	Computer systems supporting lower level business functions
	Gill (1996)	Use of expert systems for consistency and increased speed of decision making
	Walstrom and Wilson (1997)	Obtaining information related to predetermined and preformatted reports
	Palvia and Chawla (1999)	Increased use of IT for operational and administrative tasks
	Walters <i>et al.</i> (2003)	Easy access to internal and external information by using EIS
Using IS for Effectiveness	Alter (1976)	Using IS for making and implementing decisions
	McFarlan (1984)	Use of computer based technology for new competitive opportunities
	Poston and Grabski (2000)	Use of ERP for increasing customer satisfaction through integration and consistency
	Behesti (2004)	Commitment to technology for the purpose of gaining and sustaining competitive advantage
	Ranganathan and Kannabiran (2004)	IS for improving their competitiveness and overall business performance
	Chou <i>et al.</i> (2005)	Combining ERP and BI for enhancing decision-making capability inside the organization
	Moller (2005)	Conceptual framework for extended enterprise resource planning (ERP II)
	Nguyen (2007)	CRM systems for increasing customer loyalty and superior service
Supporting Managerial Tasks using IS	Ragowsky and Gefen (2008)	Use of ERP system for strategic purposes
	Adam and Murphy (1995)	Information practices of executives
	Ferratt <i>et al.</i> (1988)	Computer use by production managers
	Martinsons <i>et al.</i> (1999)	Use of balanced IS scorecard as a decision support tool
	Vlahos <i>et al.</i> (2000)	Use of IT by managers

2.3 EVALUATION OF INFORMATION SYSTEMS

Sassone (1988) discussed cost justification as an increasingly important concern among users and vendors of end user information systems. It was stated that to be successful such systems must prove themselves to be better in financial comparisons among the spectrum of corporate capital investment proposals. Costs in information systems will be immediate and tangible but the benefits will appear speculative, distant and intangible.

Goyal (1994) carried out a study on the effectiveness of MIS of the Punjab state electricity board. The study used ten attributes of information as the components of a general model used for the evaluation of MIS effectiveness. These ten attributes were timeliness, relevance, accuracy, up-to-dateness, adequacy, no-overloading, format clarity, no-duplication, explicitness and exception-based reporting.

Grover *et al.* (1996) argued that measuring the specific contribution of IS remains a critical concern of both academics and practitioners. Capturing the contribution of IS-based assets to organizational performance provides a benchmark from which the processes of IS function can be evaluated and refined. Authors have suggested two evaluation constructs, *i.e.*, organizational and individual. Further, these two constructs have been spread over evaluation types in form of process, response and impact. Combination of these two evaluation constructs and three evaluation types had been used to come up with six classes of effectiveness measures. These six effectiveness measures are infusion measures (Organizational, Process), market measures (Organizational, Response), economic measures (Organizational, Impact), usage measures (Individual, Process), perceptual measures (Individual, Response) and productivity measures (Individual, Impact).

Ragowsky *et al.* (1996) proposed and tested an approach for evaluating the benefit the organization gained by the use of individual information system applications. It was found that different organizations gain different benefits by using the same information system applications and that the benefits an organization gains from using a computerized applications increases as function of the increase of two types of independent variables representing the level of complexity and uncertainty regarding a specific activity and the impact of the decisions supported by the added information on the organization's objectives.

Saarinen (1996) argued that traditional investment analysis techniques and criteria, such as return on investment, net present value, or pay-back period could be used in evaluation of information systems, but because of the unique nature of IS investments, such methods seldom suffice in practice. As there are no generally acceptable measures available to quantitatively and objectively assess information systems' success, the evaluation of the success has to be supplemented by a subjective judgment and surrogate measures.

Chan *et al.* (1998) developed and validated a tool to measure realized information systems strategy or existing uses of information technology in the organizations. It was recognized that intended uses of technology often differ from actual uses.

Yuthas and Young (1998) highlighted that IS plays a vital role in the materials management function by providing timely and accurate information necessary for the

accomplishment of decision making goals. The managers rely extensively on the reports of IS to take important decisions. The main functions of IS are lowering cost, increasing turnover and improving service. Because of the large investments in the IS, companies have developed several ways to evaluate their effectiveness. The most direct approach is to assess the effects of IS on material management performance outcomes such as inventory costs, turnover, and fill rates. The more common approach is to assess the effectiveness by means of substitute measures, such as user perceptions and usage statistics. In laboratory experiment conducted by the authors it was found that although satisfaction and usage are closely associated with the performance, the relationship among the measures was not sufficiently strong to warrant their use as interchangeable measures of effectiveness.

Farbey *et al.* (1999) opined that there is a concern that poor evaluation procedure implies that it is difficult to select projects for investment, to control development and to measure business returns after implementation. The researchers have suggested five learning themes: more extensive use of theory of evaluation as a frame for classifying present prescriptions and discovering new ones; closer attention to multiple relationships among stakeholders; the development of more complex models of decision making; more emphasis on “whole life” studies of project dynamics and further exploration of the role of management learning.

According to Giaglis *et al.* (1999), the assessment of Information System (IS) benefits is an important practical problem in IS investment appraisal. According to them an incremental measurement approach can help an organization obtain quantitative estimates of expected IS impacts on business performance. The I.S.S.U.E. methodology described in the paper involves five steps namely Initiation, Simulation, Substantiation, Utilization and Estimation.

Seddon *et al.* (1999) stated that although there are a large number of information system effectiveness measures. But it is not clear that what measures are appropriate in a particular context. The researchers have proposed a two dimensional matrix for classifying is effectiveness measures. The two dimensions identified for the purpose are: type of system studied and stake holders in whose context the systems are being evaluated.

Levy and Powell (2000) argued that Information Systems Strategy (ISS) use is under developed and under researched in small and medium enterprises. Authors developed an approach that reflected on the role of the information as a strategic resource. It was stated that ISS recommendations in small firms need to take account of organizational change issues as much as information system implementation.

Stratopoulos and Dehning (2000) explored the issue of relating investment in IT and financial performance using a quasi-experimental design comparing successful users of IT with less successful users of IT. It was found that a successful user of IT outperforms less successful users of IT for 3-4 years. Manner in which IT assets are managed is more important than the spending on IT. It is expected that any performance advantage of the effective users of IT will tend to erode with time as competitors copy their IT investment and implementation

Byrd and Turner (2001) offered an exploratory analysis into the relationship between flexible IT infrastructure and competitive advantage. Canonical correlation analysis used to explore the relationship supported the view that there is a positive relationship between flexible IT infrastructure and competitive advantage. It was said that flexible IT infrastructure as measured by integration, modularity, and IT personnel flexibility was positively related to some organizational measures of innovativeness, mass customization, difficulty to duplicate and market position. The analysis showed that the IT personnel flexibility factor contributed the most among the factors of the flexible IT infrastructure to the relationship. IT personnel flexibility included factors such as magnitude and quality of knowledge, skills, and experiences of the personnel in developing major software applications.

According to Gunes *et al.* (2003) measuring the impact of Information Technology on organizational performance is a complicated task. Apart from IT applications factors like business strategies and organization culture should also be taken into consideration while measuring the impact of IT on overall performance.

Malik and Goyal (2003) emphasized on need for IS evaluation in context of organizational environment. In order to realize the benefits from the technology, a conducive environment for the new technology and system should be provided. Although it is difficult, to measure the benefits from IS yet some organizational evaluation

mechanism should be in place. In order to evaluate and establish organizational effectiveness for improved IS effectiveness a model comprising of three steps; adapt, collaborate and evaluate has been suggested.

Beynon-Davies *et al.* (2004) considered some of the inherent relationships between the literature on IS evaluation in terms of IS failure and organizational learning. According to the authors, low adoption rates of evaluation activity within the organizations may partly be attributed to the current gap within other established IS development approaches, methods, techniques and tools and the suggestions produced by the IS evaluation community.

Hedman and Borell (2004) stated that ERP systems evaluation is highly contextual and there is a possibility that measurements of the impact are interchangeable with the measurements of general improvements. Authors have emphasized the need to measure the impact of ERP systems using the same measurements employed in a specific organization prior to implementation. In this manner, any changes recorded can be attributable to a combination of IS implementation, organizational changes and changes in the method of measurement. Use of narratives has been proposed as the means of disseminating knowledge, which ought to lead to improvements and enhanced action during the implementation and usage of enterprise systems.

Tingling and Parent (2004) have challenged the notion that the evaluation-and-selection of enterprise technologies by firms has largely been rational and deterministic. Substantial ceremonial aspects also play an important role in the process. Results from the study indicated that intuition, symbols, rituals, and ceremony all figure prominently in the decision process. However, rather than being in conflict with the rational processes, these aspects were found to be in tension, leading to a more holistic social construction of decision processes.

Davenport (2005) opined that in future business processes will become more standardized. Presently, because of lack of process standards, outsourcing of business processes is based on cost and the faith that service provider will do a good job. Broad set of process standards will make it easy to determine whether a business capability can be improved by outsourcing it. Author has suggested three issues in addition to cost to be

considered while evaluating outsourcing options. These are: process activity and flow standards, process performance standards and process management standards. Process standardization will also be helpful in combining certain processes with competition if these processes offer no competitive advantage.

Sammon and Adam (2005) argued that unsatisfactory success rates of ERP implementations are not indications of the failure of ERP as a concept, it is the result of inadequate analysis of business requirements in preparations for ERP projects. This has resulted in organizations failing to achieve expected benefits from their implementations. New era of enterprise-wide systems introduces an increased level of complexity to an already complicated organizational initiative.

A study by Spathis and Ananiadis (2005) assessed the benefits of using an enterprise system in accounting information and management. The results showed that the benefits from the implementation of the ERP system lead to managerial benefits, followed by operational benefits and IT infrastructure benefits. ERP systems also offer the opportunity for organizations to re-engineer their activities and revamp their information systems and accounting practices. It was also suggested that the adoption of ERP systems may to some degree be conducive in attaining broad reaching goals beyond the immediate impact zone of the system itself. Results showed that user perceptions after one year of implementation were more positive as compared to their expectations in the pre-implementation period.

Chiu *et al.* (2006) argued that ERP systems are being implemented by the enterprises to gain competitive advantage and improving their business efficiency. But it becomes difficult to identify the gains in business efficiency on account of such implementations.

Gregor *et al.* (2006) investigated the nature of the IT related organizational transformation and its part in the value realized at the firm level. Transformational benefits were found to exist as a distinct category and were closely related to the other forms of IT generated business. There are diverse perspectives on the nature of the benefits of IT which include: productivity gains, increased profitability, cost reduction and competitive advantage. Factor analysis showed organizational transformational benefits were recognized as a separate category of benefits, distinct from informational, strategic and transactional benefits, but there was a relationship between the realization of the different benefits.

Ko and Osei-Bryson (2006) have argued that while IT investments have a positive impact on productivity, the impact is conditional and not uniform but depends on the investments in other areas such as non-IT labour and non-IT capital. The IT impact on productivity can be maximized when investments in other related areas are considered together, and are not considered in isolation. When the organization ignores the level of investments in each variable and other related variables, additional investments in IT can either be wasted or negatively affect overall productivity. Therefore, IT investments decisions should not be made without consideration of the levels of investments within an organization to avoid any waste in additional investments in IT.

Weill and Aral (2006) have emphasized portfolio approach for generating premium returns from IT investments. IT asset classes include four types, namely, informational, transactional, strategic and infrastructure. Authors have emphasized that being IT savvy pays and characteristics of high IT savvy companies include: intensity of electronic communication media use, internet based architecture, percent digitization of transactions executed with suppliers and customers, company wide IT skills and the degree of senior management commitment to IT projects. Companies are expected to improve their returns on IT investments by working on the above-mentioned characteristics.

Wieder *et al.* (2006) investigated impacts of several aspects of ERP systems adoption and ERP system use on firm performance and business process performance. ERP system adoption, ERP system history and ERP system extension with Supply Chain Management System were taken as independent variables while key performance Indicators for supply chain performance and firm performance as dependent variables. No significant difference was found between ERP system adopters and the control group, neither at the supply chain level nor at the overall firm level. The findings from the study indicated that earlier an ERP system was initially implemented, the higher was the overall firm performance but the same result was not applicable to supply chain performance.

According to Boyd *et al.* (2007) evaluation of IS professionals is a difficult task. Measures used for evaluation are usually not fully defined and suffer from the inability of a user to consider differences between expectations and perceptions of performance. The effective management of IS professionals is important to the success of both the IS department and the modern organizations. The results of the study showed that the user satisfaction was related to an overall measure of IS performance in terms of users' perceived delivery and users' expectations.

Thompson *et al.* (2007) have emphasized that an IS project should include assessment of three key components: task, psychological and organizational outcomes. Task outcome refers to the capability of a project to produce high quality deliverables in an efficient way. Misreporting is likely to have a negative impact on project task outcome, especially on efficiency in terms of budget and schedule overruns. Accurate, timely reporting by project team members was likely to enhance task outcomes. Psychological outcomes involve the level of team members' satisfaction with their work. Better-informed managers are more likely to engage in evenhanded decisions. Organizational outcomes are the business values that the operational systems add to the organization. Practical implication of this study is that project executives should establish communication environments that are likely to nurture open, complete reporting. Senior managers can also take steps to spot the occasional misreporting.

Table 2.3 provides the major themes of IS evaluation literature. It can be seen from this table that three types of approaches have been largely studied for evaluating IS, namely, quantitative approach, qualitative approach and context based approach. Accordingly, various studies have been categorized under these three approaches.

Table 2.3: Major Themes of Reviews regarding Evaluation of IS

Issue	Study	Contribution
Quantitative Approach to IS Evaluation	Yuthas and Young (1998)	Inventory costs and turnover as measures for performance outcome.
	Stratopoulos and Dehning (2000)	Relating investment in IT and financial performance
Qualitative Approach to IS Evaluation	Saarinen (1996)	Supplementing IS evaluation with subjective judgment and surrogate measures
	Giaglis <i>et al.</i> (1999)	Incremental measurement approach using I.S.S.U.E. methodology
	Spathis and Ananiadis (2005)	ERP system leading to managerial benefits, followed by operational benefits and IT infrastructure benefits
	Chiu <i>et al.</i> (2006)	Difficulty in identifying the gains in business efficiency because of ERP implementations.
	Ko and Osei-Bryson (2006)	Dependence of IS success on the investments in other areas such as non-IT labour and non-IT capital
Context Based Approach to IS Evaluation	Grover <i>et al.</i> (1996)	Suggestion of organizational and individual constructs
	Ragowsky <i>et al.</i> (1996)	Different organizations gain different benefits by using the same information system applications
	Seddon <i>et al.</i> (1999)	Type of system studied and stake holders as contexts of evaluation
	Gunes <i>et al.</i> (2003)	Business strategies and organization culture as important contexts for measuring IS success
	Hedman and Borell (2004)	Highly contextual nature of ERP systems evaluation

After reviewing the above literature, it can be concluded that outsourcing has been on the rise in the business enterprises. Organizational culture, perceived benefits from the information systems, political factors related to stakeholders and participation of end users play an important role in determining the success of information systems. Information systems find wide applications ranging from operational level to strategic level of the business enterprises. Investments in information systems are difficult to evaluate because of intangible nature of benefits, inappropriate techniques for measuring the effectiveness and long run nature of benefits.

2.4 RESEARCH GAPS

There are a number of studies that have been conducted in the field of IS related to outsourcing, implementation, use and evaluation in the developed countries but very few studies have been conducted in India. Regarding the very few studies related to India, it can be stated that management of IS is still in its nascent stage. No study has yet been undertaken on the use and management of IS in the manufacturing sector of Punjab. The present study is an attempt to explore the issues such as procurement, implementation, use and evaluation of IS and thus filling the existing research gap. The study is an attempt to capture the present state of use of IS and IS management practices in the manufacturing sector of Punjab. Learning from the outcome of the study is expected to improve both IS use and IS management practices in the manufacturing sector of state of Punjab.

2.5 CHAPTER SUMMARY

This chapter is aimed at reviewing the existing body of IS knowledge related to the present study. Previous studies from IS research have been grouped in three sections based on the objectives of the research. Major issues related to IS use, sourcing, implementation and evaluation have been identified and these issues will act as basis for exploring use of IS in the manufacturing sector of Punjab. The research gap that the present study aims to fulfill has also been identified.

Chapter-3

Research Design

The present chapter deals with the research questions of the research and the methodology adopted for finding out answers to these questions. Issues such as research design, sample selection, tools used for the study, data collection and data analysis have been discussed in the following sections. Details about research methodology have been presented so as to present the basic framework used for carrying out the study.

3.1 RESEARCH QUESTIONS

Manufacturing sector of a nation is considered as a key determinant for overall state and health of the whole of the economy. Technology is considered as an enabling aid for manufacturing sector. The study aims at exploring the procurement, implementation, use and evaluation of IS in the manufacturing sector of Punjab. The research questions for the present study have been designed by taking into consideration the need for the study (Section 1.7) and the objectives of the study (Section 1.8.1). The following research questions have been identified for this study:

- (i) What is the extent and type of IS use in the manufacturing sector of Punjab?
- (ii) Is there any variation in the use of IS across different levels of management?
(Hypothesis 1: There is no variation in the use of IS across different levels of management.)
- (iii) Is there any variation in the use of IS across different functional areas of management?
(Hypothesis 2: There is no variation in the use of IS across different functional areas of management.)

- (iv) What are the practices used for sourcing and implementing IS by the manufacturing organizations in Punjab?
- (v) How are information systems evaluated in the manufacturing organizations of Punjab?

The issues relating to research questions have been identified and are presented in Table 3.1. An attempt has also been made to make enquiries pertaining to satisfaction level of users and problems related to IS, apart from the issues listed in Table 3.1.

Table 3.1: Details of Research Questions

Research Question	Related Issues to be addressed
What is the extent and type of use IS in manufacturing sector of Punjab?	Extent of Use: <ul style="list-style-type: none"> • Weekly use of IS and computer based applications • Percentage of decisions based on IS and contribution of IS in these decisions • Association between use of IS and type of decision Type of Use: <ul style="list-style-type: none"> • Value of IS for supporting managerial roles • Value of IS for decision making stages • Relative importance of various types of IS
Is there any difference in the use of IS across different levels of management?	Variation with respect to managers from different levels in terms of : <ul style="list-style-type: none"> • Weekly use of IS and computer based applications • Percentage of decisions based on IS and contribution of IS in these decisions
Is there any difference in the use of IS across different functional areas of management?	Variation with respect to managers from different functional areas in terms of: <ul style="list-style-type: none"> • Weekly use of IS and computer based applications • Percentage of decisions based on IS and contribution of IS in these decisions
What are the practices used for sourcing and implementing IS by the manufacturing organizations in Punjab?	Practices related to: <ul style="list-style-type: none"> • Sourcing of IS • Major attributes considered while purchasing IS • Implementation of IS in the organization
How IS are evaluated in the manufacturing organizations of Punjab?	State of IS Evaluation: <ul style="list-style-type: none"> • Evaluation practices followed by the organizations • Evaluation by the users

3.2 RESEARCH DESIGN AND POPULATION OF THE STUDY

Exploratory study was conducted to fulfill the objectives of the study. Descriptive research design was used for conducting the study. Descriptive research design involves producing descriptions of the variables of interest. Major use of descriptive research design involves producing the depiction of a given situation. Population of the study consisted of large and medium scale limited companies of Punjab. As per available data (on 31.03.2003) 553 large and medium scale units were functioning in Punjab (Annexure-I). This information was obtained from the official website of Punjab government.

3.3 SAMPLING FRAME AND SAMPLE SELECTION

The sampling frame consisted of large and medium scale limited companies of Punjab, which were in operation at least for last five years as on 31.03.2003. Large and medium scale companies have been taken because of relatively large number of employees and large scale operations. It is expected that full fledged computer based information systems are more likely to exist in large and medium scale manufacturing firms as information systems are seen as a solution for increased complexity. Out of 553 units, about 90 units were selected and were contacted for the study as these 90 units were outperforming the averages of 400 employees per unit, fixed investment of Rs. 35 crores per unit and production of Rs. 52 crores per unit. (Calculated from Annexure-I). All the ninety units were contacted personally by the researcher and responses were obtained from 73 units. A high response rate of 81 percent was achieved due to vigorous persuasion and follow up by the researcher. Out of 73 responses, 70 usable responses were extracted. The sub-sector wise detail of these 70 units is given in Table 3.2. It is worth to mention here that these 70 units represent all major sub-sectors except for Beverages, Chemical Products, Non-Metallic Mineral Products and Electrical Machinery and Parts. Units from Beverages, Chemical Products and Electricity Machinery and Parts could not be included, as the units from these sub-sectors did not respond to the data collection efforts made by the researcher. In case of Non-Metallic Mineral Products, the units were not outperforming the average of employees per unit.

Table 3.2: Units Included in the Analysis

Sub-sector	Total No. of Units	No. of Units included in analysis
Cotton/Woolen Textiles	126	21
Basic Metal Products and Metal Products	68	16
Transport Equipment and Parts	40	10
Paper Products and Printing	32	2
Rubber and Plastic Products	15	4
Leather and Leather Products	4	2
Food Products	115	8
Machinery and Parts	12	4
Hosiery	35	3

3.4 SAMPLE SIZE

Sample for the study consisted of 70 large and medium manufacturing units. Further, from each organization 12 users of IS were included in the study. Total sample size for the users of IS came out to be 840. From each organization covered under the study, approximately 2, 4 and 6 respondents were selected from top, middle and lower level of management. Top level managers for the purpose of the study, included the respondents with designation of Vice President and above. Middle level managers were the respondents with designation of Deputy Manager and above and designations such as Assistant Manager, Management Trainee, Supervisor *etc.* were taken as lower level managers. For meeting the objectives of the study, spread of the respondents across different functional areas of management such as Marketing, Finance & Accounting, Production & Operations, Human Resource and Information Technology was ensured.

3.5 VALIDITY AND RELIABILITY OF THE TOOLS USED

For the purpose of carrying out the study, two separate questionnaires were developed. The first questionnaire (Annexure-II) was meant for the organization and the second questionnaire (Annexure-III) was meant for the user. Pilot survey of five organizations was undertaken for validating the tools used for the study. These tools were validated for face and content validity. Questionnaires used for the study were finalized by incorporating the suggestions received during the pilot survey.

Cronbach's alpha was used for testing the reliability of the set of twenty statements (Q:10, Annexure-III). It can be seen from Table 3.3 that value of Cronbach's alpha for the set of twenty statements used for evaluation of IS came out to be 0.785.

Table 3.3: Reliability for the Tool used for User Evaluation of IS

Cronbach's Alpha	0.785
Split-Half Correlation	0.804
Spearman-Brown Prophecy	0.891

Value of 0.785 was found to be well above the conventional acceptance level of 0.7 (Nunnally, 1978). Therefore, the set of the statements can be treated as reliable measurement instrument. Further, values of split-half correlation and Spearman-Brown Prophecy were found to be 0.804 and 0.891 respectively. As these values were more than 0.8, it was concluded that the instrument was also having internal consistency.

Brief details of the questionnaires used for the study is being presented in the followed discussions.

3.5.1 Questionnaire for organization

Organizational questionnaire was used to explore the process of procurement, implementation and evaluation of IS in the organization. The questionnaire was made by consulting the practitioners in the field of information systems, such as the vendors dealing in IS and the executives concerned with IS activities in their respective organizations. Questionnaire was prepared for exploring the practices related to the procurement, implementation and evaluation of IS in the manufacturing organizations. Questionnaire contained both closed ended and open-ended questions to ensure structured responses from the respondents and capture the novelty in the practices related to IS as well.

3.5.2 User questionnaire

Questionnaire for the user was aimed at exploring the use of IS in the manufacturing organizations and focused on the issues such as duration of use of IS, extent of use of IS in decision making, value of IS for supporting the managerial roles, satisfaction with respect to IS *etc.* User questionnaire was prepared by consulting the academicians and the practitioners as well as taking into consideration the previous studies conducted in the field of IS. Questionnaire, used for deriving responses from the users of IS, draws heavy inputs from Vlahos *et al.* (2000), Chin and Lee (2000) and Armstrong *et al.* (2005). Instruments used in the above-mentioned studies were changed to make the questionnaire, used for the present study, more suitable for manufacturing sector of Punjab as well as the objectives related to the use of IS. Questionnaire also contained a question pertaining to the evaluation of IS by the users. Majority of the questions asked in the user questionnaire were closed ended. Few open-ended questions were included for exploring the issues such as the problems faced while using IS and the suggestions for improving IS.

3.6 DATA COLLECTION

Primary data was collected by administering the questionnaire, interviewing the respondents and by means of direct observations by the researcher. Questionnaire meant for the organization was administered to the manager/ Head of Department looking after IS activities in the organization. User questionnaire was administered to individual users of IS in the organization. While contacting the organization, a request accompanied the questionnaire for ensuring the spread of the users across the levels as well as functional areas of management. Secondary data was collected from available documentation of information systems, annual reports and other relevant secondary sources such as trade journals, magazines, corporate publications *etc.*

3.7 DATA ANALYSIS

Data collected, by using the questionnaires, were analyzed using descriptive statistics such as frequencies, means and standard deviation as well as other suitable statistical techniques. For analyzing the data, techniques such as Analysis of Variance (ANOVA),

Chi-square test, Z-test, Kendall's test of concordance and factor analysis were used. ANOVA has been used to test for the significance of the differences in terms of use of IS among different levels and functional areas of management. Association between the use of IS and type of decision has been found using Chi-square test. Two-tailed Z-test has been used to find whether the obtained mean was significantly different from the assumed mean or not. Assumed mean was taken as the middle of the scale, *i.e.*, 3 for five-point scale and 4 for seven-point scale. Kendall's test of concordance has been used for measuring the agreement among respondents across levels and functional areas with respect to the value of IS for managerial roles, decision-making stages and relative importance of types of IS. Factor analysis has been used to summarize the variables on which IS is evaluated by the users.

3.8 CHAPTER SUMMARY

The present chapter outlines the research questions undertaken in the study and also the methodology adopted in order to find the answers to these questions. Various issues elaborating the research questions have been listed. This chapter also covers the methodology followed for the study including the sampling, the research instruments and their validity as well as the statistical techniques used for analyzing the data.

Chapter-4

Results

This chapter deals with the results obtained from this study and discusses the relevant issues. The chapter has been divided into five sections, covering the five research questions of the study.

First section deals with the overall analysis of type and extent of use of IS in the manufacturing sector of Punjab. This section broadly covers the extent of use of IS, various computer based applications, importance of IS for various managerial roles, use of IS for different type of decisions and the level of user satisfactions with respect to IS. Second section deals with the comparison of the type and extent of use of IS for the respondents across three levels of management, namely, top level managers, middle level managers and lower level managers. Individual level wise analysis has also been presented in this section. Third section deals with the comparison of the type and extent of use of IS for the respondents across five functional areas of management, namely, Information Technology managers, Finance managers, Production managers, Marketing managers and Human Resource managers. Further, analysis for individual functional areas has also been included in this section. Fourth section of this chapter deals with IS management practices followed in the manufacturing sector of Punjab. This section deals with the issues like the need for having IS in the organization, the extent of outsourcing of functions related to information systems and the attributes considered while selecting IS. IS implementation practices in the manufacturing organizations have also been detailed out in this section. Fifth section of this chapter deals with the evaluation process of IS and factor analysis related to evaluation of IS in the manufacturing organizations in Punjab. This section deals with the methods of evaluation of IS as well as factor analysis for identifying the major factors that can be used for evaluation of IS in the manufacturing sector of Punjab.

Results presented in the first, second and third sections are completely based on the questionnaire administered to the users of IS, while the fourth section is completely based on the questionnaire administered to the managers/ heads of departments looking after IS

in the organization. In case of fifth section, the results were obtained from both the questionnaires, *i.e.*, administered to users as well as to managers/heads of departments. Out of 840 respondents surveyed under the study, 746 respondents were male and 94 respondents were female. Distribution of the respondents, according to gender has been presented in Fig. 4.1.

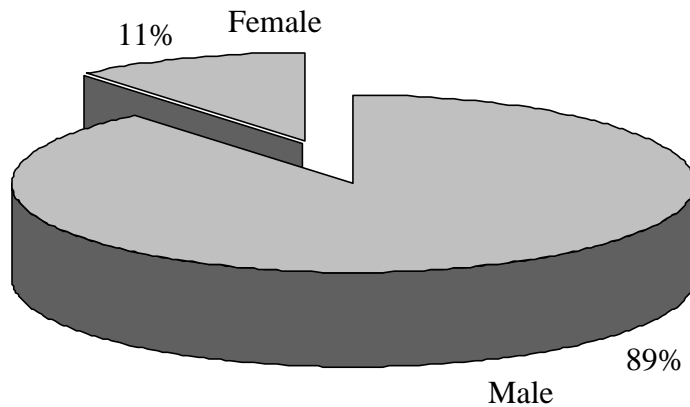


Fig. 4.1: Gender wise Distribution of the Respondents

It can be seen from the Fig. 4.1 that about 89 percent of the respondents were male and about 11 percent of the respondents were female. Majority of the respondents were male because relatively less number of females are employed in the manufacturing sector of Punjab.

In terms of educational classification, it was observed that 63 respondents were undergraduate, 362 respondents were graduate and 415 respondents were post graduate. Distribution of the respondents according to their educational qualification has been shown in Fig. 4.2. It can be seen from Fig. 4.2 that 49 percent respondents were post graduate, 43 percent respondents were graduate and about 8 percent respondents were undergraduate.

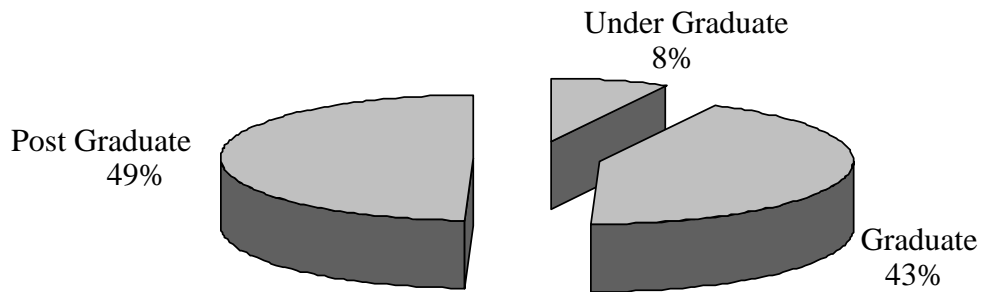


Fig. 4.2: Educational Qualification wise Distribution of the Respondents

On the basis of age, it was found that 67 respondents were aged less than 25 years, 278 respondents were falling in the age group of 25 years to 35 years, 331 respondents were falling in the age group of 35 years to 45 years and 164 respondents were aged more than 45 years. Distribution of the respondents on the basis of age has been shown in Fig. 4.3.

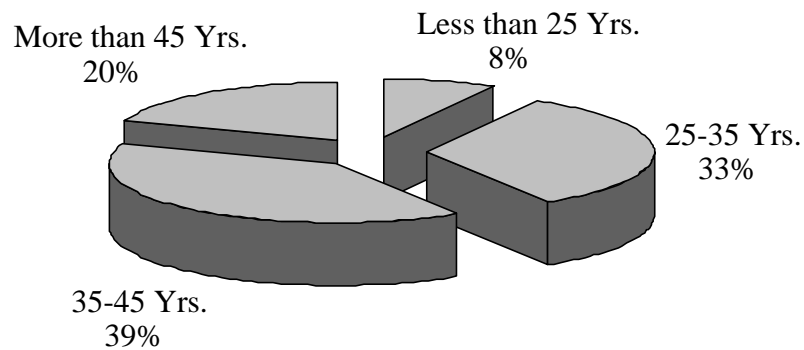


Fig. 4.3: Age wise Distribution of the Respondents

It can be seen from Fig. 4.3 that 39 percent respondents were aged from 35 years to 45 years, 33 percent respondents were in the category from 25 years to 35 years, 20 percent respondents were aged more than 45 years and about 8 percent respondents were aged less than 25 years.

4.1 TYPE AND EXTENT OF USE OF IS

This part deals with the overall use of IS, use of various computer based applications, extent of use of IS in managerial decision making, support of IS for various managerial roles and steps of decision making stages, and satisfaction of users with respect to IS.

4.1.1 Overall use of IS

Users were enquired about the level of use of IS for carrying out their job responsibilities. The results thus obtained have been shown in Table 4.1.

Table 4.1: Average use of IS by the users (n = 840)

Use of IS per week	Frequency
More than 20 hours	589 (70.12)
15-20 hours	207 (24.64)
10-15 hours	30 (3.57)
5-10 hours	14 (1.66)

Figures in parentheses are percentages

It can be seen from Table 4.1 that the majority of the users, *i.e.*, 70 percent were using IS for more than 20 hours per week. About one fourth of the users reported weekly use of IS from 15 hours to 20 hours. Only about five percent of the users were using IS for 15 hours or less on weekly basis. The results indicate relatively heavier use of IS for carrying out their job responsibilities. As the respondents under the study were the managers belonging to different levels, it can be stated that managers from the manufacturing sectors were using IS quite heavily.

Respondents were also enquired about the use of stand alone as well as interconnected terminals on weekly basis. Table 4.2 presents overall use of IS by the respondents along with extent of use of IS for making decisions. It can be seen that on weekly basis respondents were using IS for around 29.5 hours per week. It was also found that on an average around 64 percent of total decisions, being made by the users, were

Table 4.2: Overall Extent of Use of IS (*n* = 840)

Extent of Use	Mean	Std Dev
Use of IS per week (in hours)	29.52	11.82
Percentage of Decisions involving use of IS	63.58	12.34
Percentage contribution of IS based input in decisions involving use of IS	61.61	9.39

based on inputs from IS. Further, for the decisions that were based on IS inputs, sixty one percent contribution of IS based inputs was reported. Although the results did not indicate total reliance on IS for decision making in case of the managers from manufacturing sector, yet IS are being used up to a considerable extent.

4.1.2 Use of Various computer based applications

Respondents were asked about use of various computer based applications and the results thus obtained have been presented in Table 4.3. It can be seen from the table that

Table: 4.3: Use of Various Applications (Hours/Week)

Application	Mean	Std Dev	<i>n</i>
Word Processors	12.43	5.98	833 (99.16)
Internet	11.85	3.85	670 (79.76)
Spreadsheets	10.79	3.19	833 (99.16)
Database Applications	7.95	4.84	57 (6.78)
Own Programs	7.57	3.69	37 (4.40)
Specific Packages	6.68	2.07	193 (22.97)
Presentation Graphics	4.75	2.00	364 (43.33)

respondents reported maximum use of word processor and internet, 12.43 hours per week and 11.85 hours per week respectively. Use of spreadsheets was reported to be 10.79 hours per week while for database applications weekly usage was reported at 7.95 hours. Average weekly use of own programs was reported to be 7.57 hours. Specific packages

were being used for 6.68 hours per week. Use of presentation graphics was limited to 4.75 hours per week.

One way ANalysis Of Variance (ANOVA) was used to find out whether there is a significant difference across mean use of various computer based applications with the following hypothesis:

H₀: All means for weekly use of various computer based applications are equal.

ANOVA results indicated that $F_{\text{calculated}}$, *i.e.*, 189.15 ($p = 0.00$) was greater than table value, *i.e.*, 2.80 ($df = 6, 2980$ at 1 percent level of significance). Therefore, null hypothesis was rejected. It can be concluded that there was a significant difference in the mean use of various computer based applications.

Further, it can be seen from Table 4.3 that 833 respondents were using word processors and spreadsheets. While 670 respondents reported use of internet and 364 respondents were using presentation graphics. Only 57 respondents (6.8 percent) were making use of database applications and 37 respondents (4.4 percent) were working on their own programs. These results indicate that users in manufacturing sector used computer based applications mainly for the purpose of communication and analysis. Lesser use of database applications points towards lack of databases as well as inadequate ability of the users to use the existing databases.

Respondents were asked to assign importance of various computer based applications for carrying out their job responsibilities. Table 4.4 shows the importance assigned by the users for various computer based applications. It can be seen from the table that maximum importance was assigned to internet with mean value of 6.21 followed by word processors at 5.61 and spreadsheets at 5.30. The results indicate that managers in manufacturing perceive internet as the most important application for performing their job related tasks. Presentation graphics were termed as relatively less important for carrying out the managerial tasks.

Table 4.4: Importance assigned to Various Applications

Application	Mean	Std Dev
Internet	6.21	0.78
Word Processors	5.61	0.94
Spreadsheets	5.30	1.08
Database Applications	5.20	1.42
Specific Packages	5.09	0.97
Own Programs	4.69	1.88
Presentation Graphics	4.58	1.14

It can also be observed from Table 4.3 and 4.4 that the applications with maximum use were also given relatively high importance by the respondents. It is an indication of reliance of the respondents on these activities for carrying out their routine jobs.

4.1.3 Managerial roles and value of IS

Mintzberg (1990) has divided managerial roles in three categories, namely, informational roles, interpersonal roles and decisional roles. Informational roles include the role of monitor, disseminator and spokesperson. As monitor, a manager seeks and acquires work related information; as disseminator, a manager disseminates the available information to others; and as spokesperson, he/she interacts with the outsiders. Roles of figurehead, leader and liaison come under the category of interpersonal roles. As figurehead, a manager performs social and ceremonial duties; as leader, a manager directs and motivates the subordinates; and role of liaison involves establishing relationships outside the vertical chain of command. Decisional roles include the role of entrepreneur, disturbance handler, resource allocator and negotiator. As entrepreneur, a manager is responsible for initiating changes voluntarily and handles non voluntary changes in the role of disturbance handler. While deciding about the resource allocation to various tasks, a manager performs the role of resource allocator and while negotiating, both within and outside the organization, performs the role of negotiator.

Respondents were asked about value of IS for performing various managerial roles. The results have been shown in Table 4.5. It can be seen from table that except for spokesperson, the respondents reported that IS were of moderate importance for carrying out managerial roles. Top three managerial roles with highest support from IS were liaison, monitor and leader. Bottom three positions were occupied by resource allocator, figurehead and spokesperson. Obtained mean values were tested against assumed mean of 4 (middle point of 1 to 7) and it was found that mean values for all managerial roles were found to be significantly different from assumed mean except for role of spokesperson. Mintzberg (1990) has categorized managerial roles into three broad categories, *i.e.*, interpersonal roles, informational roles and decisional roles. From the available results it can be stated that for these categories, maximum value of IS was stated for decisional roles with mean of 4.98, followed by interpersonal roles with mean of 4.89 and informational roles with mean of 4.83.

Table 4.5: Value of IS for Different Managerial Roles

Managerial Role	Mean	Std Dev	n	Z
Monitor	5.30	0.93	840	40.51*
Liaison	5.19	1.00	838	34.45*
Leader	5.12	1.29	840	25.16*
Negotiator	5.06	0.95	831	32.16*
Disturbance Handler	5.05	1.00	836	30.36*
Disseminator	5.01	0.98	840	29.87*
Entrepreneur	4.97	1.15	834	24.36*
Resource Allocator	4.88	0.93	840	27.42*
Figurehead	4.37	1.35	836	7.92*
Spokesperson	3.60	0.06	447	-140.95*

(On scale of 7 being Great Value and 1 being No Value at all, tested against assumed mean = 4)

* Significant at 1% level of significance

Available results indicate that the respondents thought IS carry value for their support for making decisions.

4.1.4 Value of IS and decision making stages

Respondents were asked to report about the value of IS for different decision making stages such as identification of the problem, searching for alternatives, evaluating the available alternatives, ranking of the alternatives and choice and implementation of the chosen alternative. It can be seen from in Table 4.6 that maximum value of IS was reported for identification of the problem followed by searching alternatives and ranking alternatives. Last two positions were occupied by evaluation of alternatives and implementation respectively. Available results indicate that managers in manufacturing sector are using IS as a tool for finding out the problems.

Table 4.6: Value of IS for Different Decision Making Stages

Decision Making Stages	Mean	Std Dev	Z
Identifying Problem	5.70	0.75	65.69*
Searching Alternative	5.38	0.73	54.79*
Ranking Alternatives and Choice	5.30	0.92	40.95*
Evaluating Alternatives	5.26	0.76	48.05*
Implementation	4.81	0.92	25.52*

(On scale of 7 being Great Value and 1 being No Value at all, tested against assumed mean = 4)

* Significant at 1% level of significance

On the other hand, value of IS was reported to be relatively on the lower side for implementation of the decisions. It can be attributed to greater involvement of behavioural aspects in case of implementation as compared to other decision making stages.

4.1.5 Importance of various information systems

Respondents were requested to rank various types of Information Systems according to their importance. Table 4.7 shows ranking of various information systems. It can be seen that respondents were terming Management Information Systems (MIS) as the most important system followed by Transaction Processing Systems (TPS) and Office Automation Systems (OAS). It can be observed that Executive Support Systems (ESS),

Knowledge Work Systems (KWS), and Decision Support Systems (DSS) were considered relatively less important.

Table 4.7: Ranking of Various Information Systems

Type of Information System	Mode	Rank Sum	Rank
Management Information Systems	1	1214	1
Transaction Processing Systems	2	1821	2
Office Automation Systems	3	2695.5	3
Decision Support Systems	4	3300.5	4
Knowledge Work Systems	6	4054.5	5
Executive Support Systems	6	4616.5	6

Broadly MIS, TPS and OAS facilitate efficiency in the routine work in the organization. On the other hand, ESS, DSS and KWS find main application in enhancing effectiveness and new product/service development. Therefore, it can be stated that major plank of use of IS, in manufacturing concerns covered under the study, was efficiency.

4.1.6 Extent of use of IS based on type of decision

According to the framework given by Anthony (1965) managers broadly face three types of decisions, *i.e.*, long term or strategic decisions, mid term or tactical decisions and short term or operational decisions. The respondents were enquired about the extent of use for these different types of decisions. It can be seen from Table 4.8 that use of IS goes on increasing in the order of strategic decisions, tactical decisions and operational decisions. It can be seen that majority of responses for strategic, *i.e.*, about 82 percent fall indicate less than 60 percent use.

Table 4.8: Use of IS based information for making different decisions

Type of Decision	More than 80%	60%-80%	40%-60%	Less than 40%
Long Term	6 (0.71)	147 (17.50)	342(40.71)	345(41.07)
Medium Term	3(0.36)	352(41.90)	394(46.90)	91(10.83)
Short Term	174(20.71)	540(64.29)	119(14.17)	7(0.83)

For tactical decisions majority responses, *i.e.*, 88 percent responses are between 40 to 80 percent. In case of operational decisions approximately 85 percent responses were in sixty plus category.

Chi square test was applied on Table 4.8 with the following hypothesis:

H₀: There is no association between type of decision and extent of use of IS for making the decision.

Calculated value of chi-square came out to be 1106.40 with 6 degrees of freedom. Calculated value was found to be more than the table value of 16.81 at 6 degrees of freedom. Therefore, null hypothesis was rejected and type of decision and the extent of use IS for making the decision were found to be associated. Results indicate that users rely heavily on IS while making short term decisions while this reliance decreases for strategic decisions. During the study, it was observed that manufacturing organizations were emphasizing on simple automation and were not having higher order systems such as decision support systems and knowledge work systems in place.

4.1.7 User Satisfaction with respect to IS and problems faced by the Users

Respondents were enquired about their level of satisfaction with respect to IS. Level of satisfaction was measured on a seven point scale with 7 representing ‘Extremely Satisfied’ and 1 representing ‘Extremely Dissatisfied’. It can be seen from Table 4.9 that mean score came out to be 5.07.

Table 4.9: Level of User Satisfaction

Mean	5.07
Standard Deviation	0.83
Z	37.36*

* Significant at 1% level of significance

It indicates that the users were moderately satisfied with IS and there is a definite scope for improvement of IS in the manufacturing. Mean score was compared with assumed

mean of 4 (mid point of the scale). Results show that mean value of 5.07 was significantly different from the assumed mean of 4 at 1 percent level of significance.

Out of 840 respondents, 93 respondents, *i.e.*, about 11 percent reported problems related to the working of IS. Major problems cited by the respondents were slow speed of the system (81 responses) and lack of interconnectivity of the computer systems (23 responses). Major suggestions for the improvement of the existing system included technology up gradation and purchase of new hardware. During the study, it was observed that computer systems being used by lower level managers were quite old. Due to use of old hardware, IS were slow on speed.

Based on the results of this section, it can be stated that IS is being used to considerable extent in the manufacturing sector of Punjab and its weekly usage is 29.52 hours. Word processors and internet have been ranked high amongst the computer based applications, in terms of weekly usage. The specific packages and presentation graphics have been ranked low in these applications. Sixty four percent of the total decisions were based on IS and for these decisions the contribution of IS based input was 62 percent. Significant association was found between the extent of use of IS and type of decisions. Respondents were relying more on IS for making short term and standardized decisions as compared to medium and long term decisions. The respondents assigned maximum value of IS in terms of supporting managerial roles to decisional roles, followed by interpersonal roles and then by informational roles. Further, the respondents valued IS high for 'identifying the problem' and 'searching alternatives' in decision making stages. Management Information Systems and Transaction Processing Systems were considered more important than Decision Support Systems and Executive Support Systems. Average level of user satisfaction came out to high at value of 5.07, on a seven-point scale.

4.2 LEVEL WISE ANALYSIS

Comparison of IS use for the respondents across three levels of management has been presented in the following section. This section also includes individual level wise analysis.

4.2.1 Use of IS across different levels

In any organization, tasks being undertaken and decisions being made can differ on basis of level of hierarchy. Anthony (1965) has presented three management functions of strategic planning, management control and operational control with associated strategic decisions, tactical decisions and operational decisions respectively. Table 4.10 depicts the use of IS according to different levels of management. Top level managers were using IS for around 27 hours per week, while middle level managers and lower level managers were using IS for 31 hours and 30 hours respectively. For finding out differences in terms of the use of IS across these levels ANOVA with the following hypothesis were used:

H_0 : All means for weekly use of IS across different levels are equal.

Table 4.10: Use of IS per week according to level of management (Hours)

Level	Mean	Std Dev	<i>n</i>
Top	27.25	9.13	157
Middle	30.69	12.91	278
Lower	29.60	11.86	405

Calculated value of $F_{2,837}$ came out to be 4.30 ($p = 0.013$) which was more than table value ($F_{2,837} = 3.00$) at 5% level of significance. Therefore, null hypothesis was rejected and it was concluded that there was significant difference across different levels of management in terms of use time of IS.

It was observed that top level managers were making the least use of IS while for middle level managers, use hours were the maximum. This difference may be attributed to differences in terms of the requirement of IS for making decisions as well as the user ability to use IS.

Table 4.11 provides level-wise distribution for percentage of decisions involving use of

Table 4.11: Percentage of Decisions involving use of IS according to level of management

Level	Mean	Std Dev	<i>n</i>
Top	62.42	11.46	157
Middle	63.20	11.12	278
Lower	64.30	13.40	405

IS. It can be seen that lower level managers were relying more on IS for making decisions, followed by middle level managers and top level managers. ANOVA was used for finding if means were different across the levels.

H₀: All means for percentage of decisions involving IS across different levels are equal.

Calculated value of *F*, *i.e.*, 1.50 ($p = 0.22$) was less than table value of *F*, *i.e.*, 3.00 ($df = 2, 837$ at 5 percent level of significance), therefore, null hypothesis was accepted and results of ANOVA concluded that there was no significant difference across the levels in terms of percentage decisions based on IS.

Table 4.12 depicts percentage contribution of IS for the decisions involving use of IS. It can be seen that middle level managers were using maximum IS based inputs for making decisions, followed by top level managers and lower level managers.

H₀: All means for percentage contributions of IS based inputs in decisions involving use of IS across different levels are equal.

Table 4.12: Percentage contributions of IS based input in decisions involving use of IS according to level of management

Level	Mean	Std Dev	<i>n</i>
Top	61.91	8.18	157
Middle	62.84	6.92	278
Lower	60.64	11.06	405

Calculated value of F , *i.e.*, 4.66 ($p = 0.009$) is more than table value of F , *i.e.*, 4.61 ($df = 2, 837$ at 1 percent level of significance). Therefore, null hypothesis was rejected. Results of ANOVA concluded that there was a significant difference across the levels in terms of percentage contribution of IS based inputs in decisions involving use of IS.

4.2.2 Use of computer based applications across different levels

Table 4.13 presents the use of word processors across all three levels. It can be seen from the table that maximum use of word processor was reported by middle level managers with mean use of 12.83 hours per week, followed by mean use of 12.54 hours per week reported by lower level managers. Top level managers were using the word processor applications for 11.42 hours per week. ANOVA was used to find out whether there was a significant difference across the levels in terms of use of word processors. The following were the hypothesis:

H_0 : All means for use of word processors across different levels are equal.

Table 4.13: Use of Word Processors across Different Levels (Hours/Week)

Level	Mean	Std Dev	<i>n</i>
Top	11.42	6.33	154
Middle	12.83	6.17	278
Lower	12.54	5.67	401

With value of $F_{\text{calculated}}$, *i.e.*, 2.91 ($p = 0.054$) being less than table value of 4.61 ($df = 2, 830$ at 1 percent level of significance), null hypothesis was accepted. Therefore, it was concluded that no significant difference existed across the three levels for weekly use of word processors,

It can be seen from Table 4.14 that middle level managers were the heaviest users of spreadsheets with weekly use of 11.02 hours.

Table 4.14: Use of Spread sheets across Different Levels (Hours/Week)

Level	Mean	Std Dev	<i>n</i>
Top	10.27	3.43	154
Middle	11.02	2.77	278
Lower	10.83	3.35	401

Lower level managers were using spreadsheets for 10.83 hours per week while top level managers reported use of spreadsheets for 10.27 hours per week. ANOVA was used to find out whether there was a significant difference across the levels in terms of use of word processors. The following hypothesis was used:

H₀: All means for use of spreadsheets across different levels are equal.

Calculated value of *F*, *i.e.*, 2.82 ($p = 0.058$) came out to be less than table value of *F*, *i.e.*, 4.61 ($df = 2, 830$ at 1 percent level of significance). Therefore, null hypothesis was accepted and it was concluded that there was no significant difference across weekly use of spreadsheets across different levels.

Users reported relatively heavier use of internet across all three levels. Internet is normally used for the purpose of communication and finding out the required information from the web. According to Table 4.15 maximum use of internet was reported by middle level managers with weekly use of 12.35 hours, followed by lower level managers with mean weekly use of 11.9 hours.

Table 4.15: Use of Internet across Different Levels (Hours/Week)

Level	Mean	Std Dev	<i>n</i>
Top	10.89	3.88	134
Middle	12.35	3.68	225
Lower	11.90	3.90	311

Least use of internet was reported by top level managers with weekly use of 10.89 hours. ANOVA was applied to find out whether there was a significant difference across the levels in terms of use of internet with the following hypothesis:

H₀: All means for use of internet across different levels are equal.

ANOVA results showed that there was a significant difference across different levels as calculated value of F (6.16, $p = 0.002$) was higher than table value of 4.61 ($df = 2, 667$ at 1 percent level of significance). This difference can be explained on account of nature of job and the ability of the users to use internet.

All levels reported relatively lighter use of presentation graphics. Light use of presentation graphics can be attributed to preference of the users for word processor and spreadsheets. Table 4.16 shows that maximum use of presentation graphics was reported by lower level managers at 4.90 hours per week, followed by middle level managers at 4.89 hours per week. Minimum use of presentation graphic was in case of top level managers with weekly use value of 3.85 hours. The following hypothesis was used:

H₀: All means for use of presentation graphics across different levels are equal.

Table 4.16: Use of Presentation Graphics across Different Levels (Hours/Week)

Level	Mean	Std Dev	<i>n</i>
Top	3.85	2.09	51
Middle	4.89	1.9	122
Lower	4.90	1.99	191

Calculated value of F , *i.e.*, 6.13 ($p = 0.002$) was less than table value, *i.e.*, 3.02 ($df = 2, 361$ at 1 percent level of significance). Therefore, null hypothesis was rejected. ANOVA indicated that there was significant difference in terms of use of this application across different levels. This difference can be explained on the basis of job requirements as lower level and middle level managers are expected to use presentation graphics more as compared to top level managers.

Results reveal that there was relatively lesser use of database applications in terms of few persons using these applications as only 6.78 percent (57 out of 840) of the respondents reported use of database applications. It can be observed from Table 4.17 that middle level managers reported maximum use of database applications with weekly use of 9.18 hours followed by lower level managers with weekly use of 8 hours. Top level managers were using database applications for 5.10 hours per week.

Table 4.17: Use of Database Applications across Different Levels (Hours/Week)

Level	Mean	Std Dev	<i>n</i>
Top	5.10	1.45	10
Middle	9.18	5.85	22
Lower	8	4.38	25

ANOVA was applied with the following hypothesis:

H₀: All means for use of database applications across different levels are equal

Calculated value of *F*, *i.e.*, 2.58 ($p = 0.084$) was less than table value of *F*, *i.e.*, 4.98 ($df = 2, 54$ at 1 percent level of significance). Therefore, null hypothesis was accepted and it was found that there was no significant difference across weekly use of database applications across different levels.

Use of specific packages was more popular as compared to database applications and presentation graphics. It can be seen from Table 4.18 that lower level managers were the heaviest users of specific packages with weekly use of 7.48 hours, followed by middle level managers with use of 6.34 hours per week. Least use was reported by top level managers with mean weekly use value at 5.91 hours.

Table 4.18: Use of Specific Packages across Different Levels (Hours/Week)

Level	Mean	Std Dev	<i>n</i>
Top	5.91	1.79	47
Middle	6.34	2.06	71
Lower	7.48	2.01	75

Following hypothesis was tested using ANOVA:

H₀: All means for use of specific packages across different levels are equal.

Calculated value of F , *i.e.*, 10.72 ($p = 0.00003$) was more than table value of F , *i.e.*, 4.61 ($df = 2, 190$ at 1 percent level of significance). Therefore, null hypothesis was rejected and it was found that there was a significant difference across weekly use of specific packages across different levels.

4.2.3 User satisfaction with respect to IS

It can be seen from Table 4.19 that top level managers were comparatively more satisfied with IS as compared to other levels, with average satisfaction score of 5.27 on a scale of 1 to 7.

Table 4.19: Satisfaction with IS across different Levels

Level	Mean	Std Dev	<i>n</i>	<i>Z</i>
Lower	5.00	0.88	405	22.87*
Middle	5.07	0.72	278	24.78*
Top	5.27	0.85	157	18.72*

* Significant at 1% level of significance

Middle level managers reported satisfaction level at 5.07, while lower level managers reported the same at 5.00. ANOVA was applied to find out difference across the levels of management in terms of satisfaction level with respect to IS. The following hypothesis was tested:

H₀: All means for satisfaction with IS across different levels are equal.

Calculated value of F , *i.e.*, 6.41 ($p = 0.0017$) was more than table value, *i.e.*, 4.61 ($df = 2, 837$ at 1 percent level of significance). Therefore, null hypothesis was rejected and it was concluded that there was a significant difference among different levels on the basis of satisfaction. Comparatively higher level of satisfaction as one moves from bottom to top

in the organizational hierarchy can be explained an account of provision of better hardware as well as better IT support services.

Majority of the respondents, especially lower level managers, complained about the speed of the system. This problem was mainly because of quality of hardware being used in the manufacturing organizations.

4.2.4 Use of IS by top level managers

The following section presents type and extent of use of IS by top level managers of the manufacturing sector in Punjab. Discussion in this section encompasses use of various applications, value of IS for performing various managerial roles and for different stages of decision making, importance of various information systems and the extent of use of IS for making various types of decisions in context of responses derived from top level managers.

It can be seen from Table 4.20 that in case of top level managers, among various applications, maximum use was reported for word processor (11.4 hours per week), followed by internet (10.9 hours per week) and spreadsheets (10.3 hours per week). Weekly use of presentation graphics and database applications was reported to be 3.85 hours and 5.10 hours and these two were the least used applications.

Table 4.20: Use of Various Applications by Top Level Managers (Hours/Week)
(*n* = 157)

Application	Mean	Std Dev	<i>n</i>
Word Processors	11.42	6.33	154 (98.08)
Internet	10.89	3.88	134 (85.35)
Spread sheets	10.27	3.43	154 (98.08)
Specific Package	5.91	1.79	47 (29.93)
Database Applications	5.10	1.45	10 (6.39)
Presentation Graphics	3.85	2.09	51 (32.48)

Weekly use of specific packages stood at 5.91 hours. It can be seen that in terms of number of users, word processor and spreadsheet were placed on the top (154 each) followed by internet (134). Only 51 of 157 respondents from top level were using

presentation graphics, while only 10 respondents reported the use of database applications. It can be seen that major use of IS in case of top level managers was restricted to communication (word processor and internet) as well as analysis (spreadsheets). ANOVA was applied to find out if there is significant difference across the use time of various applications with the following hypothesis.

H₀: All means for weekly use of various computer based applications are equal for top level managers.

Calculated value of *F* statistic came out to be 35.04 (*df* = 5, 549, *p* = 0.00), which was more than table value of 3.02 (at 1 percent level of significance). Therefore, null hypothesis was rejected and it was concluded that there was significant difference in the use time of various application in case of top level managers.

Table 4.21 presents the results regarding value of IS for different managerial roles as reported by top level managers.

Table 4.21: Value of IS for Different Managerial Roles for Top Level Managers (*n* = 157)

Managerial Role	Mean	Std Dev	<i>n</i>	<i>Z</i>	Rank
Leader	5.55	1.11	157 (100.00)	17.50*	1
Monitor	5.32	0.91	157 (100.00)	18.18*	2
Liaison	5.27	1.01	157 (100.00)	15.76*	3
Negotiator	5.23	0.78	154 (98.08)	19.57*	4
Entrepreneur	5.1	1.13	157 (100.00)	12.20*	5
Figurehead	5.01	1.24	157 (100.00)	10.21*	6
Disseminator	4.96	0.77	157 (100.00)	15.62*	7
Resource Allocator	4.78	0.83	157 (100.00)	11.78*	8
Disturbance Handler	4.76	1.03	157 (100.00)	9.25*	9
Spokesperson	4.12	1.34	116 (73.88)	0.96	10

Significant at 1% level of significance

It can be seen from the table that IS was found to be having maximum value in case of managerial roles of leader, monitor and liaison and negotiator. IS was found to be relatively less valuable in case of spokesperson, disturbance handler and resource allocator. Further, it can be seen from Table 4.21 that about 26 percent of top level managers were of the opinion that the role of spokes person was not applicable to them. Calculated value of Z showed that mean score for all managerial roles was different from assumed mean of 4 except for the role of spokesperson. Average value of IS for interpersonal roles came out to be 5.27 followed by decisional roles at 4.96 and informational roles at 4.86. It can be stated that top level managers were finding IS valuable for carrying out interpersonal roles.

Table 4.22 shows the value of IS for different decision making stages as reported by top level managers, it can be observed from the table that maximum value of IS was reported for problem identification and searching for alternatives with mean scores of 5.89 and 5.52 respectively.

Table 4.22: Value of IS for Different Decision Making Stages for Top Level Managers

Decision Making Stages	Mean	Std Dev	Z
Identifying Problem	5.89	0.68	34.83*
Searching Alternative	5.52	0.84	22.67*
Ranking Alternatives and Choice	5.34	0.75	22.39*
Evaluating Alternatives	5.13	0.83	17.06*
Implementation	4.87	0.97	11.24*

* Significant at 1% level of significance

In case of choice of alternatives, support of IS was rated at mean score of 5.34. Least value of IS support was for implementation and evaluating alternatives with mean score of 4.87 and 5.13 respectively. From the observations, it can be stated that top level managers were finding IS valuable for identification of problem and possible solutions.

Top level managers were enquired about the importance of various information systems and the results have been presented in Table 4.23. It can be seen that top level users

assigned first rank to Management Information Systems. Second and third positions were occupied by Transaction Processing Systems and Office Automation Systems.

Table 4.23: Ranking of Various Information Systems by Top Level Managers

Type of Information System	Mode	Rank Sum	Rank
Management Information Systems	1	253	1
Transaction Processing Systems	2	336	2
Office Automation Systems	3	493.5	3
Decision Support Systems	4	660.5	4
Knowledge Work Systems	6	737.5	5
Executive Support Systems	6	839.5	6

According to top level managers least important information systems were ESS, KWS and DSS respectively. It can be observed from the available results that top level users were ranking information systems involving simple automation such as TPS and OAS more important as compared to support systems such as DSS, ESS and KWS. This phenomenon can be possibly explained by non-availability of higher order systems such as DSS and ESS as well as low awareness of users regarding potential use of these systems.

Table 4.24 shows the extent of use of IS by top level managers for making different types of decisions. It can be seen from the table that about 20 percent of the respondents reported less than 40 percent use of IS for making long term decisions and only 4 percent reported using IS more than 80 percent. For medium term decisions, maximum respondents, *i.e.*, about 59 percent reported 40 to 60 percent use of IS and only 4 percent reported a use of less than 40 percent. In case of short term decisions, about 64 percent respondents were using IS from 60 to 80 percent and about 20 percent users reported more than 80 percent use of IS.

Chi square test was applied with the following hypothesis:

H₀: There is no association between type of decision and extent of use of IS for making the decision for top level managers.

Table 4.24: Use of IS based information for making different decisions by Top Level Managers

Type of Decision	More than 80%	60%-80%	40%-60%	Less than 40%
Long Term	6 (3.89)	35 (22.72)	86 (55.84)	30 (19.48)
Medium Term	3 (1.94)	57 (37.01)	91 (59.09)	6 (3.89)
Short Term	31 (20.12)	98 (63.63)	25 (16.23)	3(1.94)

Calculated value of chi-square came out to be 141.53 with 6 degrees of freedom. Calculated value was found to be more than the table value of 16.81 at 6 degrees of freedom. Therefore, null hypothesis was rejected and type of decision and the extent of use IS for making the decision were found to be associated. From the analysis it can be inferred that IS were being used relatively to more extent in case of short term decisions as compared to medium term and long term decisions.

4.2.5 Use of IS by middle level managers

The following section presents type and extent of use of IS by middle level managers of the manufacturing sector in Punjab. Table 4.25 presents use of various computer based applications by middle level managers. It can be seen from the table that middle level managers reported maximum use of word processor and internet, 12.83 hours per week and 12.35 hours per week respectively. Use of spreadsheets was reported to be 11 hours per week while for database applications weekly usage was reported at 9.18 hours. Use of presentation graphics was limited on to 4.89 hours per week. ANOVA was used with the following hypothesis:

H₀: All means for weekly use of various computer based applications are equal for middle level managers.

As $F_{\text{calculated}}$, *i.e.*, 85.55 ($p = 0.00$) was greater than table value, *i.e.*, 3.02 (df = 5, 990 at 1 percent level of significance), the null hypothesis was rejected. Therefore, it was concluded that there was a significant difference in the mean use of various applications for middle level managers.

Table 4.25: Use of Various Applications by Middle Level Managers (Hours/Week)
(*n* = 278)

Application	Mean	Std Dev	<i>n</i>
Word Processors	12.83	6.17	278 (100.00)
Internet	12.35	3.68	225 (80.93)
Spread sheets	11.02	2.77	278 (100.00)
Specific Package	9.18	5.85	22 (7.91)
Database Applications	6.34	2.06	71 (25.53)
Presentation Graphics	4.89	1.9	122 (43.88)

Further, it can be seen from Table 4.25 that all the respondents of this category were using word processors and spreadsheets. About 81 percent respondents from the category reported use of internet and about 44 percent respondents were using presentation graphics. Only 22 respondents (8 percent) from middle level managers were making use of database applications. Table 4.26 presents the results regarding value of IS for different managerial roles as reported by middle level managers.

Table 4.26: Value of IS for Different Managerial Roles for Middle Level Managers
(*n* = 278)

Role	Mean	Std Dev	<i>n</i>	Z	Rank
Monitor	5.44	0.81	278 (100.00)	29.64*	1
Liaison	5.38	0.98	278 (100.00)	23.48*	2
Leader	5.34	1.02	278 (100.00)	21.90*	3
Disseminator	5.13	0.95	278 (100.00)	19.83*	4
Disturbance Handler	5.12	0.91	276 (99.28)	20.45*	5
Negotiator	5.08	1	276 (99.28)	17.94*	6
Resource Allocator	4.96	0.83	278 (100.00)	19.28*	7
Entrepreneur	4.92	1.05	276 (99.28)	14.56*	8
Figurehead	4.68	1.02	276 (99.28)	11.08*	9
Spokesperson	3.46	1.33	179 (64.38)	-5.43*	10

* Significant at 1% level of significance

It can be seen from the table that IS was found to be having maximum value in case of managerial roles of monitor, liaison and leader. IS was found to be relatively less valuable in case of spokesperson, figurehead and entrepreneur. Further, it can be seen from Table 4.26 that about 36 percent of middle level managers were of the opinion that the role of spokes person was not applicable to them. Calculated value of Z showed that mean score for all managerial roles was different from assumed mean of 4. Average value of IS for interpersonal roles came out to be 5.13 followed by decisional roles at 5.02 and informational roles at 4.84. It can be stated that middle level managers were finding IS valuable for carrying out interpersonal and decisional roles.

Table 4.27 shows the value of IS for different decision making stages as reported by middle level managers, it can be observed from the table that maximum value of IS was reported for problem identification and evaluating alternatives with mean scores of 5.73 and 5.44 respectively.

Table 4.27: Value of IS for Different Decision Making Stages for Middle Level Managers

Decision Making Stages	Mean	Std Dev	Z
Identifying Problem	5.73	0.77	37.46*
Searching Alternative	5.33	0.72	30.80*
Ranking Alternatives and Choice	5.25	0.77	27.07*
Evaluating Alternatives	5.44	0.98	24.50*
Implementation	4.63	0.98	10.72*

* Significant at 1% level of significance

In case of searching for alternatives, support of IS was rated at mean score of 5.33. Least value of IS support was for implementation and choice of alternatives with mean score of 4.63 and 5.25 respectively. From the observations, it can be stated that middle level managers were finding IS valuable for identification of problem and evaluation of alternatives.

Middle level managers were enquired about the importance of various information systems and the results have been presented in Table 4.28. It can be seen that middle

level users assigned first rank to Management Information Systems. Second and third positions were occupied by Transaction Processing Systems and Office Automation Systems.

Table 4.28: Ranking of Various Information Systems by Middle Level Managers

Type of Information System	Mode	Rank Sum	Rank
Management Information Systems	1	414	1
Transaction Processing Systems	2	613	2
Office Automation Systems	3	862	3
Decision Support Systems	4	1084	4
Knowledge Work Systems	5	1341	5
Executive Support Systems	6	1547	6

According to middle level managers least important information systems were Executive Support Systems, Knowledge Work Systems and Decision Support Systems respectively. It can be observed from the available results that middle level users were ranking information systems involving simple automation such as TPS and OAS more important as compared to support systems such as DSS, ESS and KWS.

Results for the extent of use of IS for making different type of decisions have been presented in Table 4.29. It can be seen from the table that about 30 percent of the middle level managers were using IS to less than 40 percent extent while taking long term decisions and about 48 percent reported 40 to 60 percent use of IS. For medium term decisions about 54 percent reported using IS from 40 to 60 percent and 40 percent reported the extent of use from 60 to 80 percent. Heavy use of IS was reported by middle level managers for making short term decisions, as about 92 percent reported the extent of use of more than 60 percent and 25 percent reporting use of IS more than 80 percent.

For finding out the association between the extent of use of IS and the type of decision being made chi-square test was applied.

Table 4.29: Use of IS based information for making different decisions by Middle Level Managers

Type of Decision	More than 80%	60%-80%	40%-60%	Less than 40%
Long Term	0 (0.00)	62 (22.30)	133 (47.84)	83 (29.85)
Medium Term	0 (0.00)	111 (39.92)	151 (54.31)	16 (5.75)
Short Term	68 (24.46)	189 (76.20)	21 (7.55)	0 (0.00)

H₀: There is no association between type of decision and extent of use of IS for making the decision in case of middle level managers.

Calculated value of chi-square came out to be 419.10 with 6 degrees of freedom. Calculated value was found to be more than the table value of 16.81 at 6 degrees of freedom. Therefore, null hypothesis was rejected and type of decision and the extent of use IS for making the decision were found to be associated.

4.2.6 Use of IS by lower level managers

The following section presents type and extent of use of IS by lower level managers of the manufacturing sector in Punjab. It can be seen from Table 4.30 that lower level managers reported maximum use of word processor and internet at 12.54 hours per week and 11.90 hours per week respectively. Least use was reported for presentation graphics with mean use of 4.89 hours per week. For spreadsheet and database applications weekly use was reported at 10.82 hours and 8 hours respectively.

ANOVA was used to find out if there is significant difference across the use time of various applications with the following hypothesis.

H₀: All means for weekly use of various computer based applications are equal for lower level managers.

**Table 4.30: Use of Various Applications by Lower Level Managers (Hours/Week)
(*n* = 405)**

Application	Mean	Std Dev	<i>n</i>
Word Processors	12.54	5.67	401 (99.01)
Internet	11.90	3.90	311 (76.79)
Spread sheets	10.83	3.35	401 (99.01)
Database Applications	8	4.38	25 (6.17)
Specific Package	7.48	2.01	75 (18.51)
Presentation Graphics	4.90	1.99	191 (47.16)

$F_{\text{calculated}}$, *i.e.*, 108.58 ($p = 0.00$) was greater than table value, *i.e.*, 3.02 (df = 5, 1398 at 5 percent level of significance). Therefore, null hypothesis was rejected. ANOVA result indicated that there was a significant difference in the mean use of various applications for lower level managers.

As seen in Table 4.30, the results indicate that about 99 percent lower level managers were using word processor and spreadsheets. For internet and presentation graphics, frequency of users stood at 311 (77 percent) and 191 (47 percent) respectively. For database applications only 25, *i.e.*, 6.2 percent lower level managers reported the use. It can also be seen from Table 4.30 that about 18.5 percent of lower level managers were using specific packages.

Table 4.31 presents the results regarding value of IS for different managerial roles as reported by lower level managers. It can be seen from the table that IS was found to be having maximum value in case of managerial roles of monitor, disturbance handler, liaison and negotiator. IS was found to be relatively less valuable in case of spokesperson, figurehead and leader. Further, it can be seen from Table 4.31 that about 37.5 percent of lower level managers were of the opinion that the role of spokes person was applicable to them. Calculated value of *Z* showed that mean score for all managerial roles was different from assumed mean of 4 except in case of figurehead.

Table 4.31: Value of IS for different managerial roles for lower level managers (*n* = 405)

Role	Mean	Std Dev	<i>n</i>	Z	Rank
Monitor	5.2	1	405 (100.00)	24.15*	1
Disturbance Handler	5.12	1.04	403 (99.50)	21.62*	2
Negotiator	5.06	0.98	401 (99.01)	21.66*	3.5
Liaison	5.06	0.93	403 (99.50)	22.88*	3.5
Entrepreneur	4.97	1.24	401 (99.01)	15.66*	5
Disseminator	4.94	1.07	405 (100.00)	17.68*	6
Resource Allocator	4.85	1.03	405 (100.00)	16.61*	7
Leader	4.8	1.43	405 (100.00)	11.26*	8
Figurehead	3.91	1.43	403 (99.50)	-1.26	9
Spokesperson	3.39	1.25	152 (37.53)	-6.02*	10

*Significant at 1% level of significance

Average value of IS for decisional roles came out to be 5 followed by informational roles at 4.80 and interpersonal roles at 4.59. It can be stated that middle level managers were finding IS valuable for carrying out decisional and informational roles.

Table 4.32 shows the value of IS for different decision making stages as reported by lower level managers, it can be observed from the table that maximum value of IS was reported for problem identification and searching for alternatives with mean scores of 5.60 and 5.35 respectively.

Table 4.32: Value of IS for Different Decision Making Stages for Lower Level Managers

Decision Making Stages	Mean	Std Dev	Z
Identifying Problem	5.60	0.75	42.93*
Searching Alternative	5.35	0.68	39.95*
Ranking Alternatives and Choice	5.24	0.75	33.27*
Evaluating Alternatives	5.27	0.90	28.40*
Implementation	4.91	0.83	22.06*

* Significant at 1% level of significance

In case of evaluating alternatives, support of IS was rated at mean score of 5.27. Least value of IS support was for implementation and choice of alternatives with mean score of 4.91 and 5.24 respectively. From the observations, it can be stated that lower level managers were finding IS valuable for identification of problem and search for possible alternatives.

Lower level managers were enquired about the importance of various information systems and the results have been presented in Table 4.33. It can be seen that lower level users assigned first rank to Management Information Systems. Second and third positions were occupied by Transaction Processing Systems and Office Automation Systems.

Table 4.33: Ranking of Various Information Systems by Lower Level Managers

Type of Information System	Mode	Rank Sum	Rank
Management Information Systems	1	547	1
Transaction Processing Systems	2	872	2
Office Automation Systems	3	1340	3
Decision Support Systems	4	1556	4
Knowledge Work Systems	6	1976	5
Executive Support Systems	6	2230	6

According to lower level managers least important information systems were Executive Support Systems, Knowledge Work Systems and Decision Support Systems respectively. It can be observed from the available results that lower level users were ranking information systems involving simple automation such as TPS and OAS more important as compared to support systems such as DSS, ESS and KWS. Results for the extent of use of IS for making different type of decisions have been presented in Table 4.34. It can be seen from the table that about 57 percent of lower level managers were using IS to less than 40 percent extent while taking long term decisions and about 30 percent reported 40 to 60 percent use of IS. For medium term decisions about 38 percent reported using IS from 40 to 60 percent and 45 percent reported the extent of use from 60 to 80 percent. Heavy use of IS was reported by lower level managers for making short term decisions,

as about 81 percent reported the extent of use of more than 60 percent and 19 percent reporting use of IS more than 80 percent.

Table 4.34: Use of IS based information for making different decisions by Lower Level Managers

Type of Decision	More than 80%	60%-80%	40%-60%	Less than 40%
Long Term	0 (0.00)	50 (12.34)	123 (30.37)	232(57.28)
Medium Term	0 (0.00)	184 (45.43)	152 (37.53)	69 (17.03)
Short Term	75 (18.51)	253 (62.46)	73 (18.02)	4 (0.98)

For finding out the association between the extent of use of IS and the type of decision being made chi-square test was applied on Table 4.34.

H₀: There is no association between type of decision and extent of use of IS for making the decision in case of lower level managers.

Calculated value of chi-square came out to be 580.20 with 6 degrees of freedom. Calculated value was found to be more than the table value of 16.81 at 6 degrees of freedom. Therefore, null hypothesis was rejected and type of decision and the extent of use of IS for making the decision were found to be associated.

4.2.7 Kendall test of concordance across levels of management

Kendall test of concordance was applied for finding the agreements in rankings, given by different levels of management, on the basis of the support of IS for different managerial roles as well as for different stages of decision making.

It can be seen from Tables 4.21, 4.26 and 4.31 that order of rankings for managerial roles differed across different levels of management. For finding out the whether there is agreement in the ranking of value of IS for various managerial roles, Kendall test of concordance was used with the following hypothesis:

H₀: Rankings on the basis of value of IS for various managerial roles are independent across different levels of management.

Calculated value of chi-statistics came out to be 18.94 which was more than table value of 16.92 ($df = 9$) at 5 percent level of significance. Therefore, null hypothesis was rejected and it was concluded that rankings across different levels were not independent. Value of W came out to be 0.701 which is closer to 1 as compared to zero, hence indicating that rankings were in agreement. It can be stated that different levels of management were in agreement on the following order of the ranking: monitor, liaison, leader, negotiator, disturbance handler, disseminator, entrepreneur, resource allocator, figurehead and spokesperson. According to available results maximum value of IS was associated with performing the role of a monitor and minimum value was there in case of role of spokesperson. It was also observed that null hypothesis could not be rejected at 1 percent level of significance as table value of chi-statistics at this level is 21.67

It can be found from Tables 4.22, 4.27 and 4.33 that different levels of management accorded different orders of rankings to decision making stages on the basis of value of support from IS. Kendall test of concordance was used with the following hypothesis:

H₀: Rankings on the basis of value of IS for various stages of decision making are independent across different levels of management.

Calculated value of chi-statistics came out to be 10.66, which is more than table value of 9.49 ($df = 9$) at 5 percent level of significance. Therefore, null hypothesis was rejected and it was concluded that rankings across different levels were not independent. Value of W came out to be 0.888 which is closer to 1 as compared to zero, hence indicating that rankings are in agreement. It can be stated that different levels of management were in agreement on the following order of the ranking: identification of the problem, searching for the alternatives, choice of the alternatives, evaluation of the alternatives and implementation. According to available results maximum value of IS was associated with stage of 'identification of problem' and minimum value was there in case of 'implementation' stage. It was also observed that null hypothesis could not be rejected at 1 percent level of significance as table value of chi-statistics at this level is 13.28.

The results of this section highlight that there is a significant difference across various levels in terms of weekly usage of IS and also in terms of the contribution of IS input in IS based decisions. Significant difference does not exist across various levels in terms of percentage of decisions based on IS out of the total decisions. Significant difference has been found in weekly use of internet, presentation graphics and specific packages, across different levels of management. Various levels do not significantly differ in weekly use of word processor, spreadsheets and database applications. There is an agreement across different levels of management in terms of ranking value of IS for various managerial roles and decision making stages.

4.3 FUNCTIONAL AREA WISE ANALYSIS

Comparison of the extent of use of IS for the respondents across different functional areas of management has been presented in the following section.

4.3.1 Use of IS across different functional areas

This section deals with analysis pertaining to the type and extent of use of IS across different functional areas of management. In this study five major functional areas were covered namely Finance and Accounting, Production and Operations, Marketing and Sales, Human Resource (HR) and Information Technology (IT). The following discussion is an attempt to explore the patterns of type and extent of IS use across functional areas of management.

It can be seen from Table 4.35 that IT managers were the heaviest users of IS with average weekly usage of around 44.3 hours, followed by managers dealing in the area of Finance and Accounting with weekly usage of 36.8 hours. Managers from Marketing and Sales area were having weekly usage of about 23.8 hours. Human resource managers and Production managers were comparatively lighter users with weekly usage of 22.1 hours and 21.8 hours respectively. For finding out differences in terms of the use of IS across different functional areas ANOVA was used with the following hypothesis:

H₀: All means for weekly use of IS across different functional areas are equal.

Table 4.35: Use of IS per week (in hours) according to functional areas

Functional Area	Mean	Std Dev	<i>n</i>
Marketing and Sales	23.81	6.07	177
Finance and Accounting	36.80	4.74	174
Human Resource	22.14	5.09	161
Information Technology	44.26	14.12	154
Production	21.83	5.19	174

Calculated value of $F_{4,307}$ came out to be 573.02 ($p = 0.00$) which is more than table value ($F_{4,835} = 3.32$) at 1 percent level of significance.

Therefore, null hypothesis was rejected and it was concluded that there is significant difference across different functional areas of management in terms of use time of IS.

This difference may be attributed to differences in terms of the requirement of IS for making decisions as well as the user ability to use IS.

Table 4.36 provides functional area wise distribution for percentage of decisions involving use of IS. It can be seen that Finance and Accounting as well as IT managers were relying more on IS for making decisions, followed by Human resource managers. Least use was reported by Production managers and Marketing and Sales managers. ANOVA was used for finding if means were different across different levels.

H₀: All means for percentage of decisions involving IS across different functional areas are equal.

Table 4.36: Percentage of Decisions involving use of IS according to functional areas

Functional Area	Mean	Std Dev	<i>n</i>
Marketing and Sales	62.32	14.17	177
Finance and Accounting	67.18	9.35	174
Human Resource	63.48	11.95	161
Information Technology	67.53	12.01	154
Production	57.87	11.20	174

Calculated value of F , *i.e.*, 18.92 ($p = 0.00$) is more than table value of F , *i.e.*, 3.32 ($df = 4, 835$ at 1 percent level of significance), therefore, null hypothesis was rejected and results of ANOVA concluded that there was a significant difference across the functional areas in terms of percentage decisions based on IS.

Table 4.37 depicts contribution of IS in terms of percentage, for the decisions involving use of IS. It can be seen that IT managers and Marketing and Sales managers were using maximum IS based inputs for making decisions, followed by Human Resource managers. Least use was reported in case of Production managers and Finance and Accounting managers.

Table: 4.37 Percentage contributions of IS based input in decisions involving use of IS according to functional areas

Functional Area	Mean	Std Dev	<i>n</i>
Marketing and Sales	63.11	9.53	177
Finance and Accounting	60.29	9.52	174
Human Resource	62.86	8.97	161
Information Technology	63.18	9.34	154
Production	58.85	8.79	174

H₀: All means for percentage contributions of IS based input in decisions involving use of IS across different functional areas are equal.

Calculated value of F , *i.e.*, 7.78 ($p = 0.000003$) is more than table value of F , *i.e.*, 3.32 ($df = 4, 835$ at 1 percent level of significance). Therefore, null hypothesis was rejected. Results of ANOVA concluded that there was a significant difference across functional areas in terms of percentage contribution of IS based inputs in decisions involving use of IS.

4.3.2 Use of various computer based applications across functional areas

The following section deals with application wise analysis with respect to various applications being used in the manufacturing concerns.

It can be seen from Table 4.38 that word processor was a heavily used application across all three levels. Observations from the table indicate that Human Resources managers were the heaviest users of word processors, with weekly use value of 12.89 hours. IT managers and Finance managers reported average weekly use of word processors at 12.68 hours and 12.27 hours respectively.

**Table 4.38: Use of Word Processors across Different Functional Areas
(Hours/Week)**

Area	Mean	Std Dev	<i>n</i>
Information Technology	12.68	7.04	154
Finance	12.29	5.16	174
Production	12.07	5.33	171
Marketing	12.27	5.72	173
Human Resource	12.89	6.63	161

Marketing managers were using word processors for 12.27 hours per week, while the same value in case of Production managers was found to be 12.07 hours. ANOVA was used with the following hypothesis:

H₀: All means for use of word processors across different functional areas are equal.

With value of $F_{\text{calculated}}$, *i.e.*, 0.52 ($p = 0.72$) less than table value of 3.32 ($df = 4, 828$ at 1 percent level of significance, null hypothesis was accepted. This showed that there was no significant difference across the three levels for the use of word processors.

Heaviest use of spreadsheets was observed in case of Human Resource managers with average weekly use value of 11.65 hours, followed by Finance managers at 11.26 hours per week. Spreadsheets were also being used to relatively heavier extent by users across all levels. Spreadsheets are used for purpose of reporting and analysis. ANOVA indicated that there was a significant difference across weekly use of spreadsheets across different levels.

Table 4.39: Use of Spread Sheets across Different Functional Areas (Hours/Week)

Area	Mean	Std Dev	<i>n</i>
Information Technology	10.45	3.31	154
Finance	11.26	3.04	174
Production	10.21	3.78	171
Marketing	10.38	2.83	173
Human Resource	11.65	2.66	161

IT managers and Marketing managers were using spreadsheets applications for 10.45 hours per week and 10.38 hours per week. Across different functional areas, least use of spreadsheet applications was reported by Production managers *i.e.* 10.21 hours per week. ANOVA was used on Table 4.39 with the following hypothesis:

H₀: All means for use of spread sheets across different functional areas are equal.

Calculated value of *F*, *i.e.*, 6.62 ($p = 0.00002$) is more than table value of *F*, *i.e.*, 3.32 ($df = 4, 828$ at 1 percent level of significance). Therefore, the alternate hypothesis was accepted. This difference can be explained on account of nature of job for Human Resource managers, which involves considerable extent of report preparation and processing.

Table 4.40 presents use of internet across various functional areas of management.

Table 4.40: Use of Internet across Different Functional Areas (Hours/Week)

Area	Mean	Std Dev	<i>n</i>
Information Technology	11.92	4.19	110
Finance	11.88	4.53	144
Production	11.44	3.61	150
Marketing	13.37	3.54	129
Human Resource	10.77	2.79	137

It can be seen from the table that maximum use of internet was reported by Marketing managers with average weekly use of 13.37 hours. IT managers and Finance managers were using internet for 11.92 hours and 11.88 hours respectively, on weekly basis. Least use of internet was reported by Production and Human Resource managers with average weekly use value of 11.44 hours and 10.77 hours respectively. ANOVA was applied, using the following hypothesis:

H₀: All means for use of internet across different functional areas are equal.

As calculated value of F , *i.e.*, 8.54 ($p = 0.000001$) was found to be more than table value of 3.32 ($df = 4,665$ at 1 percent level of significance), so, null hypothesis was rejected and it was concluded that there was a significant difference across the functional areas in terms of use of internet. This difference can be explained on account of the job requirement of Marketing managers. Marketing job involves communicating a lot with the buyers and the field salespersons. This communication is usually done by using internet.

It can be seen from Table 4.41 that maximum use of presentation graphics was reported by Production and Marketing managers with average weekly use of 5.25 hours and 5.10 hours. Human Resource managers were using this application for 4.94 hours per week, while Finance managers reported weekly use of 4.21 hours.

**Table 4.41: Use of Presentation Graphics across Different Functional Areas
(Hours/Week)**

Area	Mean	Std Dev	<i>n</i>
Information Technology	3.84	1.73	56
Finance	4.21	1.74	70
Production	5.25	2.19	95
Marketing	5.10	1.95	83
Human Resource	4.94	1.91	60

Least use of presentation graphics was observed in case of IT managers. ANOVA was used with the following hypothesis:

H₀: All means for use of presentation graphics across different functional areas are equal.

Calculated value of *F*, *i.e.*, 6.83 ($p = 0.00002$) was found to be higher than table value of 3.32 ($df = 4, 357$ at 1 percent level of significance). Therefore, alternate hypothesis was accepted and it was concluded that there was a significant difference across the mean use of presentation graphics across various functional areas of management

Results reveal that there was relatively lesser use of database applications in terms of few persons using these applications. It can be seen from Table 4.42 that IT managers and Human Resource managers were using database applications for 10.78 hours per week and 8 hours per week respectively. Marketing managers and Finance managers reported weekly use of database applications at 7.33 hours and 6.57 hours respectively.

**Table 4.42: Use of Database Applications across Different Functional Areas
(Hours/Week)**

Area	Mean	Std Dev	<i>n</i>
Information Technology	10.78	6.04	23
Finance	6.57	2.21	14
Production	4.42	2.07	12
Marketing	7.33	2.73	6
Human Resource	8	0	2

Least use of database applications was observed in case of Production managers. ANOVA was used for finding out difference across various functional areas in terms of use of database applications:

H₀: All means for use of database applications across different functional areas are equal.

Calculated value of F , *i.e.*, 4.97 ($p = 0.001$) was greater than table value of 3.65 ($df = 4, 52$ at 5 percent level of significance). Therefore, by accepting the alternate hypothesis, it was concluded that significant difference was there in use of database applications across various levels. This difference can be explained on account of relatively heavier use by IT managers.

It can be seen from Table 4.43 that Finance managers reported maximum use of specific packages with average weekly value of 8.47 hours. IT managers and Human Resource managers were using specific packages to the extent of 7.56 hours per week and 6.5 hours per week. Minimum use was reported by Marketing managers and Production managers.

**Table 4.43: Use of Specific Packages across Different Functional Areas
(Hours/Week)**

Area	Mean	Std Dev	<i>n</i>
Information Technology	7.56	2.19	41
Finance	8.47	1.43	30
Production	5.19	2.08	26
Marketing	6.37	1.57	65
Human Resource	6.5	1.70	31

ANOVA was applied on Table 4.43, with the following hypothesis:

H₀: All means for use of specific packages across different functional areas are equal.

Calculated value of F , *i.e.*, 17.33 ($p = 0.00$) was found to be higher than table value of 3.32 ($df = 4, 188$ at 1 percent level of significance). Therefore, alternate hypothesis was accepted and it was concluded that there was a significant difference across various functional areas in terms of use of specific packages. This difference can be attributed to relatively more use of specific packages such as Tally, in case of Finance and Accounting managers.

4.3.3 Satisfaction with IS across functional areas

It can be seen from Table 4.44 that IT managers, with average satisfaction score of 5.18, were comparatively more satisfied with IS as compared to other managers.

Table 4.44: Satisfaction of Users with IS

Level	Mean	Std Dev	<i>n</i>	<i>Z</i>
Finance	5.09	0.76	174	18.92*
IT	5.18	1.00	154	14.64*
HR	5.13	0.81	161	17.70*
Marketing	4.86	0.70	177	16.35*
Production	5.12	0.86	174	17.18*

* Significant at 1% level of significance

Finance managers reported satisfaction level at 5.09, while Human Resource managers reported the same at 5.13. Out of all the categories minimum satisfaction was reported by Marketing managers with score of 4.86. ANOVA was used, with the following hypothesis:

H₀: All means for satisfaction with IS across functional areas are equal.

Calculated value of *F*, *i.e.*, 3.99 ($p = 0.003$) was more than table value, *i.e.*, 3.32 ($df = 4, 835$ at 1 percent level of significance). Therefore, alternate hypothesis was accepted and it was concluded that there was a significant difference among different levels on the basis of satisfaction.

4.3.4 Use of IS by IT managers

It can be seen from Table 4.45 that in case of IT managers, among various applications, maximum use was reported for word processors (12.68 hours per week), followed by internet (11.92 hours per week) and database applications (10.78 hours per week). Weekly use of spreadsheets and presentation graphics was reported to be 10.45 hours and 3.83 hours respectively. It can be seen that major use of IS in case of IT managers was

restricted to communication (word processor and internet) as well as database applications.

Table 4.45: Use of Various Applications by IT Managers (Hours/Week) ($n = 154$)

Application	Mean	Std Dev	<i>n</i>
Word Processors	12.68	7.04	154 (100.00)
Internet	11.92	4.19	110 (71.42)
Database Applications	10.78	6.04	23 (14.93)
Spread sheets	10.45	3.31	154 (100.00)
Specific Package	7.56	2.19	41 (26.62)
Presentation Graphics	3.84	1.73	56 (36.36)

ANOVA was applied to find out if there is significant difference across the use time of various applications. The following hypothesis were used:

H₀: All means for weekly use of various computer based applications are equal for IT managers.

Calculated value of F statistic came out to be 32.76 ($p = 0.00$), which is more than table value of 3.02 ($df = 5, 532$ at 5 percent level of significance). So, null hypothesis was rejected and it was concluded that there is significant difference in the use time of various application in case of IT managers

Table 4.46 presents the results regarding value of IS for different managerial roles as reported by IT managers. It can be seen from the table that IS was found to be having maximum value in case of managerial roles of liaison, leader and monitor. IS was found to be relatively less valuable in case of spokesperson, figurehead and resource allocator. Further, it can be seen from Table 4.46 that about 50 percent of lower level managers were of the opinion that the role of spokes person was not applicable to them. Calculated value of Z showed that mean score for all managerial roles was different from assumed mean of 4 except in case of figurehead.

Table 4.46: Value of IS for different managerial roles for IT Managers ($n = 154$)

Role	Mean	Std Dev	n	Z	Rank
Liaison	5.47	1.05	152 (98.70)	17.26*	1
Leader	5.11	1.26	154 (100.00)	10.93*	2
Monitor	5.06	1.15	154 (100.00)	11.44*	3
Entrepreneur	5.01	1.22	152 (98.70)	10.21*	4.5
Disseminator	5.01	1.04	154 (100.00)	12.05*	4.5
Negotiator	4.93	1.05	150 (97.40)	10.85*	6
Disturbance Handler	4.85	1.11	152 (98.70)	9.44*	7
Resource Allocator	4.8	0.89	154 (100.00)	11.15*	8
Figurehead	4.15	1.26	152 (98.70)	1.47	9
Spokesperson	3.5	1.59	78 (50.64)	-2.78*	10

* Significant at 1% level of significance

Average value of IS for interpersonal roles came out to be 4.91 followed by decisional roles at 4.89 and informational roles at 4.72. It can be stated that IT managers were finding IS valuable for carrying out interpersonal and decisional roles.

Table 4.47 shows the value of IS for different decision making stages as reported by IT managers, it can be observed from the table that maximum value of IS was reported for problem identification and choice of alternatives with mean scores of 5.54 and 5.34 respectively.

Table 4.47: Value of IS for Different Decision Making Stages for IT Managers

Decision Making Stages	Mean	Std Dev	Z
Identifying Problem	5.54	0.66	28.96*
Searching Alternative	5.23	0.74	20.63*
Ranking Alternatives and Choice	5.34	0.77	21.60*
Evaluating Alternatives	4.99	1.16	10.59*
Implementation	4.77	0.96	9.95*

* Significant at 1% level of significance

In case of searching for the alternatives, support of IS was rated at mean score of 5.23. Least value of IS support was for implementation and evaluation of alternatives with

mean score of 4.99 and 4.77 respectively. From the observations, it can be stated that lower level managers were finding IS valuable for identification of problem and choice of alternatives.

IT managers were enquired about the importance of various information systems and the results have been presented in Table 4.48. It can be seen that lower level users assigned first rank to Management Information Systems. Second and third positions were occupied by Transaction Processing Systems and Office Automation Systems.

Table 4.48: Ranking of Various Information Systems by IT Managers

Type of Information System	Mode	Rank Sum	Rank
Management Information Systems	1	253	1
Transaction Processing Systems	1	305	2
Office Automation Systems	4	579	3
Decision Support Systems	4	589	4
Knowledge Work Systems	6	715	5
Executive Support Systems	6	826	6

According to IT managers, the least important information systems were Executive Support Systems, Knowledge Work Systems and Decision Support Systems respectively. Results for the extent of use of IS for making different type of decisions have been presented in Table 4.49. It can be seen from the table that about 27 percent of IT managers were using IS to less than 40 percent extent while taking long term decisions and about 56.5 percent reported 40 to 60 percent use of IS.

For medium term decisions, about 55 percent reported using IS from 40 to 60 percent and 36 percent reported the extent of use from 60 to 80 percent.

Table 4.49: Use of IS based information for making different decisions by IT Managers

Type of Decision	More than 80%	60%-80%	40%-60%	Less than 40%
Long Term	0 (0.00)	26 (16.88)	87 (56.49)	41 (26.62)
Medium Term	0 (0.00)	55 (35.71)	85 (55.19)	14 (9.09)
Short Term	36 (23.37)	79 (51.29)	39 (25.32)	0 (0.00)

Heavy use of IS was reported by IT managers for making short term decisions, as about 75 percent reported the extent of use of more than 60 percent and 23 percent reporting use of IS more than 80 percent. Chi square test was applied with the following hypothesis:

H₀: There is no association between type of decision and extent of use of IS for making the decision in case of IT managers.

Calculated value of chi-square came out to be 166.76 with 6 degrees of freedom. Calculated value was found to be more than the table value of 16.81 at 6 degrees of freedom. Therefore, null hypothesis was rejected and type of decision and the extent of use IS for making the decision were found to be associated.

4.3.5 Use of IS by finance managers

Finance managers reported maximum use of word processor and internet, 12.29 hours per week and 11.88 hours per week respectively. Use of spreadsheets was reported to be 11.26 hours per week. Use of presentation graphics was limited to 4.21 hours per week and the weekly usage of database applications was reported to be 6.57 hours.

**Table 4.50: Use of Various Applications by Finance Managers (Hours/Week)
(n = 174)**

Application	Mean	Std Dev	n
Word Processors	12.29	5.16	174 (100.00)
Internet	11.88	4.53	144 (82.75)
Spread sheets	11.26	3.04	174 (100.00)
Specific Package	8.47	1.43	30 (17.24)
Database Applications	6.57	2.21	14 (8.04)
Presentation Graphics	4.21	1.74	70 (40.22)

Further, it can be seen from Table 4.50 that maximum respondents (174) of this category were using word processors and spreadsheets. Only 14 respondents (8 percent) from this

category were making use of database applications. ANOVA was used with the following hypothesis:

H₀: All means for weekly use of various computer based applications are equal for Finance managers.

$F_{\text{calculated}}$, *i.e.*, 51.01 ($p = 0.00$) was greater than table value, *i.e.*, 3.02 (df = 5, 546 at 1 percent level of significance). Therefore, null hypothesis was rejected. ANOVA results indicate that there was a significant difference in the mean use of various applications for Finance managers.

Finance and Accounting managers were enquired about the value of IS for performing various managerial roles and the available results have been presented in Table 4.51. It can be observed from the table that maximum value of IS was reported for carrying the roles of monitor, leader, negotiator and liaison with scores of 5.37, 5.29, 5.17 and 5.16 respectively.

Table 4.51 Value of IS for different managerial roles for Finance Managers

Role	Mean	Std Dev	<i>n</i>	<i>Z</i>	Rank
Monitor	5.37	0.76	174 (100.00)	23.78*	1
Leader	5.29	1.09	174 (100.00)	15.61*	2
Negotiator	5.17	1.03	174 (100.00)	14.98*	3
Liaison	5.16	0.91	174 (100.00)	16.81*	4
Disseminator	5.15	0.97	174 (100.00)	15.64*	5
Entrepreneur	5.13	1.07	174 (100.00)	13.93*	6
Disturbance Handler	5.05	1.15	174 (100.00)	12.04*	7
Resource Allocator	4.96	0.9	174 (100.00)	14.07*	8
Figurehead	4.31	1.35	174 (100.00)	3.03*	9
Spokesperson	3.35	1.37	86 (49.42)	-4.40*	10

* Significant at 1% level of significance

Least values were observed for the roles of spokesperson, figurehead and resource allocator with mean values 3.35, 4.31 and 4.96 respectively. Values of IS for performing the role of disseminator, entrepreneur and disturbance handler were reported at 5.15, 5.13 and 5.05 respectively. All means were tested against the assumed mean value of 4 using Z-test. Value of Z was found to be significant at 1 percent level of significance for all managerial roles. Average value of IS for decisional roles came out to be 5.07 followed by interpersonal roles at 4.91 and informational roles at 4.88. It can be stated that Finance managers were finding IS valuable for carrying out decisional and interpersonal roles. Table 4.52 shows the value of IS for different decision making stages as reported by Finance managers, it can be observed from the table that maximum value of IS was reported for problem identification and evaluating alternatives with mean scores of 5.64 and 5.39 respectively.

Table 4.52: Value of IS for Different Decision Making Stages for Finance Managers

Decision Making Stages	Mean	Std Dev	Z
Identifying Problem	5.64	0.64	33.80*
Searching Alternative	5.29	0.73	23.31*
Ranking Alternatives and Choice	5.12	0.72	20.52*
Evaluating Alternatives	5.39	0.70	26.19*
Implementation	4.99	1.01	12.93*

* Significant at 1% level of significance

For searching the alternatives, support of IS was rated at mean score of 5.29. Least value of IS support was for implementation and choice of alternatives with mean score of 4.99 and 5.12 respectively. From the observations, it can be stated that Finance managers were finding IS valuable for identification of problem and evaluation of possible alternatives. Results regarding the importance of various information systems, for Finance managers, have been presented in Table 4.53. It can be seen that the respondents from this category assigned first rank to Management Information Systems.

Table 4.53: Ranking of Various Information Systems by Finance Managers

Type of Information System	Mode	Rank Sum	Rank
Management Information Systems	1	244	1
Transaction Processing Systems	2	383	2
Office Automation Systems	3	560	3
Decision Support Systems	4	665	4
Knowledge Work Systems	6	882	5
Executive Support Systems	6	938	6

Second and third positions were occupied by Transaction Processing Systems and Office Automation Systems. Least important information systems, for Finance managers, were Executive Support Systems, Knowledge Work Systems and Decision Support Systems respectively.

Results for the extent of use of IS for making different type of decisions have been presented in Table 4.54. It can be seen from the table that about 43 percent of Finance managers were using IS to less than 40 percent extent, while taking long term decisions and about 38 percent reported 40 to 60 percent use of IS. For medium term decisions about 28 percent reported using IS from 40 to 60 percent and 54 percent reported the extent of use from 60 to 80 percent. Heavy use of IS was reported by Finance managers for making short term decisions, as about 79 percent reported the extent of use of more than 60 percent and 37 percent reporting use of IS more than 80 percent.

Table 4.54: Use of IS based information for making different decisions by Finance Managers

Type of Decision	More than 80%	60%-80%	40%-60%	Less than 40%
Long Term	0 (0.00)	34 (19.54)	65 (37.53)	75 (43.10)
Medium Term	0 (0.00)	94 (54.02)	48 (27.58)	32 (18.39)
Short Term	62 (35.63)	75 (43.10)	35 (20.11)	2 (1.14)

Chi square test was applied on Table 4.54 with the following hypothesis:

H₀: There is no association between type of decision and extent of use of IS for making the decision for Finance managers.

Calculated value of chi-square came out to be 235.07 with 6 degrees of freedom. Calculated value was found to be more than the table value of 16.81 at 6 degrees of freedom. Therefore, null hypothesis was rejected and type of decision and the extent of use IS for making the decision were found to be associated, in case of Finance managers.

4.3.6 Use of IS by production managers

Production managers reported maximum use of word processor and internet at 12.07 hours per week and 11.44 hours per week respectively. Minimum use was reported for database applications at 4.42 hours per week. For spreadsheet and presentation graphics weekly use was reported as 10.21 hours and 5.25 hours respectively. In case of specific packages average weekly use was 5.19 hours.

Table 4.55: Use of Various Applications by Production Managers (Hours/Week)
(*n* = 174)

Application	Mean	Std Dev	<i>n</i>
Word Processors	12.07	5.33	171 (98.27)
Internet	11.44	3.61	150 (86.20)
Spread sheets	10.21	3.78	171 (98.27)
Presentation Graphics	5.25	2.19	95 (54.59)
Specific Package	5.19	2.08	26 (14.94)
Database Applications	4.42	2.07	12 (6.89)

Table 4.55 indicates that 98 percent respondents from this category were using word processor and spreadsheets. For internet and presentation graphics frequency of users stood at 150 and 95 respectively. For database applications, only 12, *i.e.*, 6.9 percent production managers reported the use. ANOVA was used with the following hypothesis:

H₀: All means for weekly use of various computer based applications are equal for Production managers.

$F_{\text{calculated}}$, *i.e.*, 52.60 ($p = 0.00$) was greater than table value, *i.e.*, 3.02 ($df = 5, 619$ at 1 percent level of significance). Therefore, alternate hypothesis was accepted and it was concluded that there was a significant difference in the weekly use of various applications.

Value of IS for supporting different type of managerial roles, in case of Production managers has been shown in Table 4.56. It can be seen from the results maximum value was reported for the role of monitor. Mean value for negotiator, disturbance handler and resource allocator came out to be 5.37, 5.13 and 5.10 respectively. Bottom four positions were occupied by roles of spokesperson, figurehead, disseminator and liaison with mean values of 4.03, 4.22, 4.88 and 4.89 respectively. Means for various managerial roles were tested against assumed mean value of 4 and the results have been shown in Table 4.56. It can be seen that means for all managerial roles differed significantly from the assumed mean. Mean values for different categories of managerial roles were calculated from the available data and it was found that mean value for decisional roles came out to be 5.13. In case of informational roles and interpersonal roles, mean values were found to be 4.91 and 4.70 respectively.

Table 4.56: Value of IS for different managerial roles for Production Managers ($n = 174$)

Role	Mean	Std Dev	<i>n</i>	Z	Rank
Monitor	5.40	0.87	174 (100.00)	21.23*	1
Negotiator	5.37	0.86	169 (97.12)	20.71*	2
Disturbance Handler	5.13	0.76	172 (98.85)	19.50*	3
Resource Allocator	5.10	0.83	174 (100.00)	17.48*	4
Leader	4.99	1.27	174 (100.00)	10.28*	5
Entrepreneur	4.93	1.41	174 (100.00)	8.70*	6
Liaison	4.89	0.95	174 (100.00)	12.36*	7
Disseminator	4.88	0.82	174 (100.00)	14.16*	8
Figurehead	4.22	1.43	172 (98.85)	2.02**	9
Spokesperson	4.03	1.41	88 (50.57)	0.20	10

* Significant at 1% level of significance

** Significant at 5% level of significance

Table 4.57 shows the value of IS for different decision making stages as reported by Production managers, it can be observed from the table that maximum value of IS was reported for problem identification and searching for alternatives with mean scores of 5.92 and 5.56 respectively.

Table 4.57: Value of IS for Different Decision Making Stages for Production Managers

Decision Making Stages	Mean	Std Dev	Z
Identifying Problem	5.92	0.75	33.77*
Searching Alternative	5.56	0.79	26.05*
Ranking Alternatives and Choice	5.17	0.76	20.31*
Evaluating Alternatives	5.16	0.89	17.19*
Implementation	4.78	0.78	13.19*

* Significant at 1% level of significance

In case of choice of alternatives, support of IS was rated at mean score of 5.17. Least value of IS support was for implementation and evaluation of alternatives with mean scores of 4.78 and 5.16 respectively. From the observations, it can be stated that Production managers were finding IS valuable for identification of problem and search for possible alternatives.

Production managers were enquired about the importance of various information systems and the results have been presented in Table 4.58.

Table 4.58: Ranking of Various Information Systems by Production Managers

Type of Information System	Mode	Rank Sum	Rank
Management Information Systems	1	225	1
Transaction Processing Systems	2	386	2
Office Automation Systems	3	519.5	3
Decision Support Systems	4	703.5	4
Knowledge Work Systems	5	845.5	5
Executive Support Systems	6	979.5	6

It can be seen that Production managers assigned first rank to Management Information Systems. Second and third positions were occupied by Transaction Processing Systems and Office Automation Systems. It can be seen that for Production managers, the least important information systems were Executive Support Systems, Knowledge Work Systems and Decision Support Systems respectively.

Results for the extent of use of IS for making different type of decisions have been presented in Table 4.59.

Table 4.59: Use of IS based information for making different decisions by Production Managers

Type of Decision	More than 80%	60%-80%	40%-60%	Less than 40%
Long Term	6 (3.44)	30 (17.24)	64 (36.78)	74 (42.52)
Medium Term	3 (1.72)	72 (41.37)	82 (47.12)	17 (9.77)
Short Term	25 (14.36)	142 (81.60)	4 (2.29)	3 (1.72)

It can be seen from the table that about 43 percent of the respondents in this category were using IS to less than 40 percent extent and about 37 percent reported 40 to 60 percent use of IS, while taking long term decisions. For medium term decisions about 47 percent reported using IS from 40 to 60 percent and 41 percent reported the extent of use from 60 to 80 percent. Heavy use of IS was reported by lower level managers for making short term decisions, as about 96 percent reported the extent of use of more than 60 percent and 14 percent reporting use of IS more than 80 percent.

Chi square test was applied on Table 4.59 with the following hypothesis:

H₀: There is no association between type of decision and extent of use of IS for making the decision in case of Production managers.

Calculated value of chi-square came out to be 260.83 with 6 degrees of freedom. Calculated value was found to be more than the table value of 16.81 at 6 degrees of freedom. Therefore, null hypothesis was rejected and type of decision and the extent of use IS for making the decision were found to be associated.

4.3.7 Use of IS by marketing managers

Marketing managers reported maximum use of internet, word processor and spreadsheets at 13.37 hours per week, 12.27 and 10.37 hours per week respectively. Use of database application was reported to be 7.33 hours per week while for presentation graphics weekly usage was reported at 5.1 hours. Further, it can be seen from Table 4.60 that about 98 percent respondents of this category were using word processors and spreadsheets. Only 6 respondents (3.38 percent) from this category were making use of database applications.

Table 4.60: Use of Various Applications by Marketing Managers (Hours/Week)
(*n* = 177)

Application	Mean	Std Dev	<i>n</i>
Internet	13.37	3.54	129 (72.88)
Word Processors	12.27	5.72	173 (97.74)
Spread sheets	10.38	2.83	173 (97.74)
Database Applications	7.33	2.73	6 (3.38)
Specific Package	6.37	1.57	6 (3.38)
Presentation Graphics	5.10	1.95	83 (46.89)

ANOVA was applied to find out whether there is a significant difference in terms of use of various computer base applications in case of Marketing managers with the following hypothesis:

H₀: All means for weekly use of various computer based applications are equal for Marketing managers.

$F_{\text{calculated}}$, *i.e.*, 70.84 ($p = 0.00$) was greater than table value, *i.e.*, 3.02 ($df = 5, 623$ at 1 percent level of significance). Therefore, null hypothesis was rejected and it was concluded that there was a significant difference in the mean use of various applications for middle level managers.

Table 4.61 shows responses of Marketing managers regarding the support value provided by IS for performing various managerial roles. Highest mean score was observed for the

role of monitor with mean value of 5.31. Disseminator, liaison, and negotiator roles were having mean values of 5.08, 5.02 and 5.01 respectively. Roles of disturbance handler and leader were having mean value of 4.94 each. Bottom four positions were occupied by spokesperson, figurehead, resource allocator and entrepreneur with mean values of 3.88, 4.62, 4.66 and 4.91 respectively.

Table 4.61: Value of IS for different managerial roles for Marketing Managers (*n* = 177)

Role	Mean	Std Dev	<i>n</i>	<i>Z</i>	Rank
Monitor	5.31	0.99	177 (100.00)	17.60*	1
Disseminator	5.08	0.99	177 (100.00)	14.51*	2
Liaison	5.02	1.01	177 (100.00)	13.44*	3
Negotiator	5.01	0.87	177 (100.00)	15.45*	4
Disturbance Handler	4.94	0.92	177 (100.00)	13.59*	5.5
Leader	4.94	1.43	177 (100.00)	8.75*	5.5
Entrepreneur	4.91	0.92	173 (100.00)	13.01*	7
Resource Allocator	4.66	1.17	177 (100.00)	7.50*	8
Figurehead	4.62	1.12	177 (100.00)	7.36*	9
Spokesperson	3.88	1.01	101 (57.06)	-1.19	10

Significant at 1% level of significance

Average value of IS for informational roles came out to be 4.90 followed by decisional roles at 4.87 and interpersonal roles at 4.86. It can be stated that Marketing managers were finding IS valuable for carrying out informational and decisional roles.

Marketing managers were enquired about the value of IS for different decision making stages and the results thus obtained have been presented in Table 4.62. It can be seen from the table that highest mean value was observed for identification of problem at 5.85, followed by ranking and choice of alternatives at 5.53. In case of evaluation of alternatives, mean score came out to be 5.51.

Table 4.62: Value of IS for Different Decision Making Stages in case of Marketing Managers

Decision Making Stages	Mean	Std Dev	Z
Identifying Problem	5.85	0.88	27.97*
Searching Alternative	5.29	0.67	25.62*
Ranking Alternatives and Choice	5.53	0.72	28.27*
Evaluating Alternatives	5.51	0.95	21.15*
Implementation	4.44	0.87	6.73*

* Significant at 1% level of significance

Implementation phase and searching for alternatives phase were placed at the bottom with mean score of 4.44 and 5.29 respectively. It can be stated that Marketing managers were finding IS relatively more valuable for identifying the problem.

Table 4.63 shows the ranking of various information systems as reported by marketing managers.

Table 4.63: Ranking of Various Information Systems by Marketing Managers

Type of Information System	Mode	Rank Sum	Rank
Management Information Systems	1	265	1
Transaction Processing Systems	2	400	2
Office Automation Systems	3	525	3
Decision Support Systems	4	698	4
Knowledge Work Systems	5	855	5
Executive Support Systems	6	970	6

It can be seen that Marketing managers assigned first rank to Management Information Systems. Second and third positions were occupied by Transaction Processing Systems and Office Automation Systems. According Marketing managers least important information systems were Executive Support Systems, Knowledge Work Systems and Decision Support Systems respectively.

It can be seen from Table 4.64 that marketing managers were using IS heavily for making short term decisions. About 79 percent of the respondents from this category were using

IS to the extent of 60 to 80 percent for making short term decisions. In case of medium term decisions, majority of the respondents, *i.e.*, 62 percent reported the use of IS from 40 to 60 percent. For long term decisions, about 44 percent of the respondents were using IS to the extent of less than 40 percent. Chi square test was applied with the following hypothesis:

H₀: There is no association between type of decision and extent of use of IS for making the decision in case of Marketing managers.

Table 4.64: Use of IS based information for making different decisions by Marketing Managers

Type of Decision	More than 80%	60%-80%	40%-60%	Less than 40%
Long Term	0 (0.00)	24 (13.55)	76 (42.93)	77 (43.50)
Medium Term	0 (0.00)	51 (28.81)	110 (62.14)	16 (9.03)
Short Term	10 (5.64)	139 (78.53)	28 (15.81)	0 (0.00)

Calculated value of chi-square came out to be 275.50 with 6 degrees of freedom. Calculated value was found to be more than the table value of 16.81 at 6 degrees of freedom. Therefore, null hypothesis was rejected and type of decision and the extent of use IS for making the decision were found to be associated.

4.3.8 Use of IS by human resource managers

Human Resource (HR) managers reported maximum use of word processor, spreadsheets and internet, *i.e.*, 12.89 hours per week, 11.65 hours per week and 10.76 hours per week

Table 4.65: Use of Various Applications by HR Managers (Hours/Week) (n = 161)

Application	Mean	Std Dev	n
Word Processors	12.89	6.63	161 (100.00)
Spread sheets	11.65	2.66	161 (100.00)
Internet	10.77	2.79	137 (85.09)
Database Applications	8	0	2 (1.24)
Specific Package	6.5	1.70	31 (19.25)
Presentation Graphics	4.94	1.91	60 (37.26)

respectively. Use of database applications was reported to be 8 hours per week while for presentation graphics weekly usage was reported at 4.94 hours. Further, it can be seen from Table 4.65 that all the respondents of this category were using word processors and spreadsheets. Only 2 respondents (1.24 percent) from this category were making use of database applications. The following hypothesis were used for ANOVA:

H₀: All means for weekly use of various computer based applications are equal for Human Resource managers.

$F_{\text{calculated}}$, *i.e.*, 42.56 ($p = 0.00$) was found to be greater than table value, *i.e.*, 3.02 ($df = 5, 546$ at 1 percent level of significance). Therefore, alternate hypothesis was accepted and it was concluded that there was a significant difference in the mean use of various applications for Human Resource managers.

Table 4.66 presents the results regarding value of IS for different managerial roles as reported by Human Resource managers.

Table 4.66: Value of IS for different managerial roles for HR Managers ($n = 161$)

Role	Mean	Std Dev	<i>n</i>	Z	Rank
Liaison	5.57	0.75	161 (100.00)	26.56*	1
Monitor	5.35	0.82	161 (100.00)	20.89*	2
Disturbance Handler	5.29	1.02	161 (100.00)	16.05*	3
Leader	5.27	1.34	161 (100.00)	12.03*	4
Negotiator	4.99	0.88	161 (100.00)	14.27*	5
Entrepreneur	4.91	1.12	161 (100.00)	10.31*	6.5
Disseminator	4.91	1.08	161 (100.00)	10.69*	6.5
Resource Allocator	4.86	0.77	161 (100.00)	14.17*	8
Figurehead	4.55	1.52	161 (100.00)	4.59*	9
Spokesperson	3.24	1.17	94 (58.38)	-6.30*	10

* Significant at 1% level of significance

It can be seen from the table that support from IS was found to be having maximum values in case of managerial roles of liaison, monitor, disturbance handler and leader with

means of 5.57, 5.35, 5.29 and 5.27 respectively. IS was found to be relatively less valuable in case of spokesperson, figurehead and leader. Calculated value of Z showed that mean score for all managerial roles was different from assumed mean of 4.

Human resource managers reported maximum value of IS for interpersonal roles with mean value of 5.13, followed by decisional roles (5.01) and informational roles (4.70).

It can be seen from Table 4.67 that maximum value of IS was reported for identification of problems with score of 5.51. Searching for alternatives and their evaluation were placed at second and third position with scores of 5.50 and 5.41 respectively. Bottom positions were occupied by implementation and choice of alternatives with mean scores of 5.14 and 5.09 respectively.

Table 4.67: Value of IS for Different Decision Making Stages for HR Managers

Decision Making Stages	Mean	Std Dev	Z
Identifying Problem	5.51	0.71	26.99*
Searching Alternative	5.50	0.64	29.74*
Ranking Alternatives and Choice	5.14	0.77	18.79*
Evaluating Alternatives	5.41	0.75	23.85*
Implementation	5.09	0.83	16.66*

* Significant at 1% level of significance

Respondents from this category considered Management Information Systems as most important information systems.

Table 4.68: Ranking of Various Information Systems by HR Managers

Type of Information System	Mode	Rank Sum	Rank
Management Information Systems	1	227	1
Transaction Processing Systems	2	347	2
Office Automation Systems	3	512	3
Decision Support Systems	4	645	4
Knowledge Work Systems	5	757	5
Executive Support Systems	6	903	6

It can be seen from Table 4.68 that Transaction Processing Systems and Office automation systems were placed at second and third positions, while Decisions Support Systems and Knowledge Work Systems were at fourth and fifth positions respectively. According to Human Resource managers, Executive Support systems were least important out of all information systems.

Results for the extent of use of IS for making different type of decisions have been presented in Table 4.69. It can be seen from the table that about 49 percent of Human Resource managers were using IS to less than 40 percent extent while taking long term decisions and about 31 percent reported 40 to 60 percent use of IS. For medium term decisions about 43 percent reported using IS from 40 to 60 percent and about 50 percent reported the extent of use from 60 to 80 percent. Heavy use of IS was reported by lower level managers for making short term decisions, as about 91 percent reported the extent of use of more than 60 percent and about 25 percent reporting use of IS more than 80 percent.

Table 4.69: Use of IS based information for making different decisions by HR Managers

Type of Decision	More than 80%	60%-80%	40%-60%	Less than 40%
Long Term	0 (0.00)	33 (20.49)	50 (31.05)	78 (48.44)
Medium Term	0 (0.00)	80 (49.68)	69 (42.85)	12 (7.45)
Short Term	41(25.46)	105 (65.21)	13 (8.07)	2 (1.24)

Chi square test was applied with the following hypothesis:

H₀: There is no association between type of decision and extent of use of IS for making the decision in case of Human Resource managers.

Calculated value of chi-square came out to be 266.86 with 6 degrees of freedom. Calculated value was found to be more than the table value of 16.81 at 6 degrees of freedom. Therefore, null hypothesis was rejected and type of decision and the extent of use IS for making the decision were found to be associated.

4.3.9 Kendall test of concordance across functional areas of management

Kendall test of concordance was applied for finding the agreements in rankings, given by different functional areas of management, on the basis of the support of IS for different managerial roles as well as for different stages of decision making. It can be seen from Tables 4.46, 4.51, 4.56, 4.61 and 4.66 that order of rankings for managerial roles differed across different functional areas of management. For finding out the whether there is agreement in the ranking of value of IS for various managerial roles, Kendall test of concordance was used with the following hypothesis:

H₀: Rankings on the basis of value of IS for various managerial roles are independent across different functional areas of management.

Calculated value of chi-statistics came out to be 33.07 which is more than table value of 21.67 ($df = 9$) at 1 percent level of significance. Therefore, null hypothesis was rejected and it was concluded that rankings across different functional areas were not independent. Value of W came out to be 0.735 which is closer to 1 as compared to zero, hence indicating that rankings are in agreement. It can be stated that different functional areas of management were in agreement on the following order of the ranking: monitor, liaison, leader, negotiator, disseminator, disturbance handler, entrepreneur, resource allocator, figurehead and spokesperson. According to available results maximum value of IS was associated with performing the role of a monitor and minimum value was there in case of role of spokesperson.

It can be found from Tables 4.47, 4.52, 4.57, 4.62 and 4.67 that different functional areas of management accorded different orders of rankings to decision making stages on the basis of value of support from IS. Kendall test of concordance was used with the following hypothesis:

H₀: Rankings on the basis of value of IS for various stages of decision making are independent across different functional areas of management.

Calculated value of chi-statistics came out to be 16.16 which is more than table value of 13.28 ($df = 9$) at 1 percent level of significance. Therefore, null hypothesis was rejected and it was concluded that rankings across different functional areas were not independent. Value of W came out to be 0.808 which is closer to 1 as compared to zero, hence indicating that rankings are in agreement. It can be stated that different functional areas of management were in agreement on the following order of the ranking: identification of the problem, searching for the alternatives, evaluation of the alternatives, choice of the alternatives and implementation. According to available results maximum value of IS was associated with stage of 'identification of problem' and minimum value was there in case of 'implementation' stage.

From the results of this section, it can be concluded that there is a significant difference across various functional areas in terms of the weekly usage of IS, percentage of decisions based on IS and the contribution of IS input in IS based decisions. Significant difference has also been noted in weekly use of spreadsheets, internet, database applications, presentation graphics and specific packages, across different functional areas. Various functional areas of management do not show significant difference in weekly usage of word processor. There is an agreement across different functional areas in terms of ranking value of IS for various managerial roles and decision making stages.

4.4 SOURCING AND IMPLEMENTATION PRACTICES

This section deals with the profile of the manufacturing organizations covered under the study as well as the procurement of IS. This analysis is based on the responses from the questionnaire that was administered to Managers/ Head of Departments looking after IS in the organizations covered in the survey. An attempt has been made to discuss the process of procurement of IS, factors affecting the selection of IS and the vendor and the performance of IS and the vendors.

4.4.1 Profile of organizations covered under the study

Table 4.70 presents the profile of the manufacturing organizations covered under the study. It can be seen from the table that ten different industry groups were covered under the study. On the basis of number of employees working in these organizations, it can be

stated that about 60 percent of the organizations were having number of employees ranging from 500 to 1000. For about 39 percent of the organizations, number of employees was more than 1000. Only in case of one organization, the number of employees was less than 500.

Table 4.70: Classification of the organizations according to Level of Employment

Industry Group	Level of Employment			Total
	<500	500-1000	>1000	
Cotton/Woolen Textiles	0	9	12	21
Basic Metal Products/Metal Products	0	14	2	16
Transport Equipment and Parts	0	5	5	10
Paper Products and Printing	0	2	0	2
Rubber and Plastic Products	0	2	2	2
Leather and Leather Products	1	1	0	2
Food Products	0	6	2	8
Machinery and Parts	0	3	1	4
Hosiery	0	0	3	3
Total	1(1.42)	42 (60.00)	27 (38.57)	70 (100.00)

Table 4.71 shows the organizations covered under the study on the basis of fixed investment. Three categories were made on the basis of fixed investment and it can be seen that about 49 percent of the organizations covered under the study were having fixed investment worth more than Rs. 100 crores.

Table 4.71: Classification of the organizations according to Level of Fixed Investment

Industry Group	Fixed Investment (Rs. Crore)			Total
	<50	50-100	>100	
Cotton/Woolen Textiles	0	5	16	21
Basic Metal Products/Metal Products	0	12	4	16
Transport Equipment and Parts	0	1	9	10
Paper Products and Printing	0	2	0	2
Rubber and Plastic Products	0	3	1	4
Leather and Leather Products	1	1	0	2
Food Products	0	6	2	8
Machinery and Parts	0	2	2	4
Hosiery	0	3	0	3
Total	1 (1.42)	35 (50.00)	34 (48.57)	70 (100.00)

Further, it can be seen from the table that only one organization was having fixed investment of less than Rs. 50 crores

Table 4.72 shows the classification of the organizations covered under the study on the basis of level of annual production. Three categories were made for the purpose of classification, *i.e.*, less than Rs. 100 crores, from Rs. 100 crores to Rs. 200 Crores and more than Rs. 200 Crores. It can be seen from the table that majority of the organizations covered under the study were having annual production of more than Rs. 200 Crores, while about 36 percent of the organizations were falling in the range from Rs. 100 Crores to Rs. 200 Crores. About 4.28 percent organizations were having annual production figures of less than Rs. 100 Crores.

Table 4.72: Classification of the organizations according to Level of Annual Production

Industry Group	Annual Production (Rs. Crore)			Total
	<100	100-200	>200	
Cotton/Woolen Textiles	0	5	16	21
Basic Metal Products/Metal Products	2	11	3	16
Transport Equipment and Parts	0	3	7	10
Paper Products and Printing	0	0	2	2
Rubber and Plastic Products	0	1	3	4
Leather and Leather Products	1	1	0	2
Food Products	0	1	7	8
Machinery and Parts	0	2	2	4
Hosiery	0	1	2	3
	3 (4.28)	25 (35.71)	42 (60.00)	70 (100.00)

Classification on basis of number of employees, level of fixed investment and level of annual production has been done merely for presentation of the data pertaining to the profile of the organizations covered under the study. It must be noted that no analysis has been done on the basis of this categorization, as the same would have been beyond the scope of the objectives of the study.

4.4.2 Duration and reason for using IS

The respondents were enquired about the length of time for which current IS were being used in the organization. Mean value of duration of IS by the manufacturing organizations under the study came out to be 7.3 years. It can be stated that the organizations have been using IS for a considerable period of time. Table 4.73 shows the reasons cited by the respondents for using IS. It can be seen from the table that majority of the organizations were using IS for eliminating the inaccuracies and inefficiencies in the working of the organization that can arise while working with manual systems. Reducing the cost as well as integration across various functional areas also emerged as the major reasons for employing IS in the organizations.

Table 4.73: Reason for having IS in the Organization (n = 70)

Reason	Frequency*
For eliminating inaccuracies and inefficiencies	66 (94.28)
For reducing the cost	64 (91.42)
For integration of various functional areas	62 (88.57)
For flawless customer service	49 (70.00)
To attain competitive edge in business	32 (45.71)
Because others are also having IS	9 (12.85)
Miscellaneous	8 (11.42)

*Respondents were allowed to tick more than one option

Providing customer service and attaining competitive advantage were part of the secondary priority. Few respondents stated that controlling the business activities while being away from the place of the work was a reason for using IS. It can be seen from the results that IS were seen as tools for improving the internal performance of the organizations as compared to garnering competitive advantage or providing direct benefits to the customers. Major focus of the manufacturing organizations under the survey in terms of use of IS was on eliminating the inefficiencies and reducing the cost.

4.4.3 Outsourcing of information system functions

For exploring the process of procurement the respondents were enquired about the level of outsourcing of Information Systems (IS) functions. The results thus obtained have been presented in Table 4.74.

Table 4.74: Level of Outsourcing of IS Functions (n = 70)

IS Functions Outsourced	Average Level of Outsourcing (%)
Software Development	67.78
Development of fully integrated system	67.28
Equipment Maintenance Service	66.64
User Training and Education	48.71
Data Communication Networks	48.42
Software Maintenance	44.00
Data Entry	15.57

It can be seen from the table that software development, development of fully integrated systems and equipment maintenance services were the functions that were relatively highly outsourced. Software maintenance, data communication networks and user training education functions were relatively less outsourced. Respondents preferred in-house services in case of data entry. Results indicate that manufacturing organizations were not going all-out for outsourcing IS functions. It was observed during the study that large manufacturing organizations were having in-house staff even for functions such as equipment maintenance service and user training and education. This tendency may be attributed to preference to lesser reliance on outside parties as well as lack of trust on external vendors by the manufacturing organizations.

Respondents were asked about the reasons for preferring outsourcing over the in-house activities and results thus obtained have been shown in Table 4.75. Fifty nine respondents indicated preference to outsourcing on account of specialized knowledge and best practices that accompany outsourcing. Twenty six respondents aimed at improving the performance of IS functions by using outsourcing.

Table 4.75: Reasons for Preferring Outsourcing (n = 70)

Reason	Frequency*
Access to specialized Knowledge and Best Practices	59
For improving the Performance	26
To have better quality of services	18
Lack of in-house Skill	12
Time Constraint	11
Cost effectiveness	3

*Respondents were allowed to tick more than one option

Other reasons cited for outsourcing IS functions were lack of in-house skills and time constraints. Only three respondents cited cost effectiveness as the reason for outsourcing IS functions. It can be stated that the major reason for outsourcing of IS functions was specialized knowledge and best practices that the vendors bring along. Improving the performance of IS functions and pursuit for better quality were the other main reasons for preferring outsourcing.

Further, respondents were asked about the reasons for not outsourcing IS functions. It can be seen from Table 4.76 that the prominent reason for not outsourcing IS functions was availability of in-house skill (68 responses) followed by the security concerns (20 responses).

Table 4.76: Reasons for not Preferring Outsourcing

Reason	Frequency*
Availability of in-house skill	68
Security Risk	20

*Respondents were allowed to tick more than one option

Largely, data entry operations in the manufacturing concerns were being performed in-house, as in-house skills are usually available for carrying out data entry operations. In addition, security concerns also lead the organizations to desist from outsourcing.

4.4.4 Procurement process of IS

For exploring the procurement process of IS, the respondents were asked about the manner in which contact was established with the vendors for purchasing IS, number of vendors contacted, decisions about the level of investment and buying roles *etc.*

Results pertaining to manner of establishing contact with the vendor have been shown in Table 4.77. Available results indicate that about 61 percent organizations contacted vendors for procuring IS on their own, in 49 percent cases vendors took the lead to establish contact and only in one instance tender was floated for finding the vendor.

Table 4.77: Manner of Establishing Contact with the Vendor ($n = 70$)

Method	Frequency*
Buyer approached the vendors	43 (61.42)
Vendor approached on their own	34 (48.57)
Tender was floated	1 (1.42)

*Multiple responses were observed

Available results indicate lack of marketing efforts on part of vendors as well as presence of few vendors. During the study, it was observed that most of the organizations were using the systems provided by SAP and few were using software developed by the local vendors. On average, organizations claimed establishing contact with two vendors for procuring IS.

Table 4.78 deals with the decision pertaining to level of investment in IS. It can be seen from the table that for 38 organizations level of investment in IS depended upon the final negotiated price with the vendor.

Table 4.78: Decision regarding Level of Investment in IS ($n = 70$)

Method	Frequency
As per Final Negotiated Price	38 (54.28)
Budget made prior to contacting vendors	32 (45.71)
Consultant Hired	7 (10.00)

Thirty two organizations reported making a budget before contacting the vendor and in seven cases external consultants were hired to find out the level of required investment. The results indicate lack of planning on part of manufacturing concerns as 54 percent of the manufacturing organizations were undecided on level of investment before contacting the vendors. Procurement process included interacting with the vendors for making the purchase. Overall 60 organizations went for having vendor presentations and 33 reported to have seen on site running of the system before making the purchase. Trial versions were used by 14 organizations, while only three visited vendor's place for enquiring about the product. It can be stated that majority of the organization were relying on vendor presentations for making the purchase decision.

An enquiry was made regarding different buying roles performed with in the organization at the time of purchase of IS. This enquiry was in form of an open ended question and the results have been presented in Table 4.79.

Table 4.79 Buying Roles for Purchasing IS (n = 33)

Buying Roles	Department		Level of Decision Making		Type of Decision	
	IT	Non-IT	Top	Middle	Group	Individual
Initiator	28 (84.84)	5 (15.15)	26 (78.78)	7 (21.21)	28 (84.84)	5 (15.15)
Influencer	27 (81.81)	6 (18.18)	16 (48.48)	17 (51.51)	19 (7.57)	14 (42.42)
Decider	30 (90.90)	3 (9.09)	33 (100.00)	0 (0.00)	24 (72.72)	9 (27.27)
Buyer	10 (30.30)	23 (69.69)	27 (81.81)	6 (18.18)	17 (51.51)	16 (48.48)

It can be seen that largely IT department played the buying roles except for the role of 'buyer'. Results indicate limited participation on part of non-IT departments/ individual for specifying the needs for having IS in the organization. For majority of the organization that responded for the query pertaining to buying roles, procurement process of IS was being handled by IT department. Only at the time of buying services of other departments (Purchase department in the majority of cases) were pressed into action. For all the responses, final decision regarding the choice of IS was taken by top level management. It can be seen from Table 4.79 that in 51 percent cases middle level management played the role of the influencer.

Broadly, it can be stated that procurement of IS was being considered important by manufacturing organizations as majority of decisions related to procurement were being taken at the top level. Further, it can be seen from the results that individual decision making was also in practice for different buying roles. IS are supposed to have enterprise wide applications and accordingly their purchase should be done by putting group decision making to use. Presence of individual decision making can be attributed to the fact that most of the manufacturing organizations in Punjab are controlled by first/second generation entrepreneurs. This factor can be responsible for a tendency on part of top level management to control important decisions within the organization.

4.4.5 Factors affecting selection of IS and vendor

Respondents were asked to rate various attributes affecting selection of IS and the vendor. Five point rating scale was used for this purpose with 5 representing 'Extremely Important' and 1 representing 'Not Important At All'. Results obtained have been shown in Table 4.80. Z-test was used to find out whether the obtained mean score was significantly different from the assumed mean of 3 (middle point of the scale). It can be seen from Table 4.80 that security, accuracy, integrity and fit with the business were the major factors that affected the selection of IS and vendor with mean scores of 4.72, 4.71, 4.63 and 4.62 respectively. Relevance of IS to the business and domain knowledge, reputation and experience of the vendor were also termed as important attributes by the respondents. Return on Investment, Brand, Payback period and compatibility with the existing applications were termed as relatively lesser important with mean scores of 3.46, 3.38, 3.33 and 3.07 respectively. All these factors except for compatibility with the existing applications and Payback Period were found to be significant at 1 percent level of significance. Mean score for compatibility with the existing business applications was found to be significant at 5 percent level.

Table 4.80: Factors affecting selection of IS and Vendor

Factor	Mean	SD	Z
Security	4.72	0.48	29.98*
Accuracy	4.71	0.6	23.84*
Integrity	4.63	0.6	22.73*
Fit with the Business	4.62	0.75	18.07*
Relevance to Business	4.45	0.88	13.79*
Domain Knowledge	4.36	1.04	10.94*
Reputation	4.33	1.01	11.02*
Experience	4.33	0.74	15.04*
Maintenance	4.2	0.58	17.31*
Time	4.1	0.67	13.74*
Scope of Customization	4.07	0.91	9.84*
Price	3.93	0.87	8.94*
Features	3.87	0.71	10.25*
Return On Investment	3.46	1.04	3.7*
Brand	3.38	0.64	4.97*
Compatibility with existing applications	3.33	1.11	2.49**
Pay Back Period	3.07	1.12	0.52

* Significant at 1% level of significance

** Significant at 5% level of significance

It can be seen from the results that at the time of purchase more importance was given to IS as compared to the vendor as it can be seen from Table 4.80 that attributes such as security, accuracy, and integrity scored over domain knowledge, reputation and experience.

4.4.6 Rating of performance of IS and vendor

Respondents were asked to rate performance of IS and vendor. Five point rating scale was used for this purpose with 5 representing 'Excellent' and 1 representing 'Poor'. Results obtained have been shown in Table 4.81. Z-test was used to find out whether the mean score was significantly different from the assumed mean of 3 (middle point of the scale). It can be seen from table 24 that top factors included security (4.43), accuracy

(4.35), vendor experience (4.33) and integrity (4.29). While relatively poor performance was reported on part of compatibility with the existing applications (3.61), maintenance (3.51), Return on Investment (3.51) and payback period (3.35). All mean scores were found to be significant at 1 percent level of confidence. It can be stated that the manufacturing organizations were relatively more satisfied with security, accuracy of IS and the experience of the vendors.

Table 4.81: Satisfaction level with respect to IS and Vendor

Factor	Mean	SD	Z
Security	4.43	0.74	16.17*
Accuracy	4.35	0.64	17.65*
Experience	4.33	0.61	18.24*
Integrity	4.29	0.67	16.11*
Scope of Customization	4.26	0.8	13.18*
Relevance to Business	4.16	0.76	12.77*
Fit with the Business	4.1	0.86	10.7*
Features	4.04	0.21	41.43*
Domain Knowledge	3.97	0.87	9.33*
Reputation	3.87	0.48	15.16*
Price	3.8	0.4	16.73*
Time	3.72	0.57	10.57*
Brand	3.62	0.6	8.65*
Compatibility with existing applications	3.61	0.81	6.3*
Maintenance	3.51	0.58	7.36*
Return On Investment	3.51	0.76	5.61*
Pay Back Period	3.35	0.73	4.01*

* Significant at 1% level of significance

According to available results, the respondents were relatively less satisfied with pay back period, Return on Investment and maintenance of IS.

4.4.7 Implementation of IS

The following discussion is focused on the procedure and methodologies, adopted by the manufacturing firms covered under the study, during the implementation of IS. This section deals with the extent of use of feasibility studies, customization, change management, top management support, conversion strategies and project management activities undertaken by the organizations at the time of implementation of IS.

4.4.7.1 Pre-implementation activities

It was found that organizations were very selective in undertaking feasibility studies. Results regarding undertaking feasibilities before undertaking IS have been shown in Table 4.82. According to the available results only 20 percent of total manufacturing organizations covered under the study undertook organizational feasibility; about 16 percent reported undertaking economic feasibility, operational and technical feasibility before the implementation of IS.

Table 4.82 Pre-implementation Activities Undertaken ($n = 70$)

Activity	Frequency
Organization Feasibility	14 (20.00)
Economic Feasibility	11 (15.71)
Technical Feasibility	11 (15.71)
Operational Feasibility	11 (15.71)
Legal Feasibility	7 (10.00)
System Analysis	34 (48.57)
System Design	23 (32.85)

About 49 percent respondents reported undertaking System Analysis and about 33 percent reported use of system design. It can be seen that majority of manufacturing organizations had not undertaken feasibility studies. This shows lack of awareness and planning in context of IS management.

Table 4.83: Duration of Pre-implementation Activities

Activity	Average Time (Weeks)
Organization Feasibility	3.33
Economic Feasibility	3.60
Technical Feasibility	1.70
Operational Feasibility	1.42
Legal Feasibility	1.71
System Analysis	5.13
System Design	6.63

Table 4.83 presents the average time used for conducting various pre-implementation activities. It can be seen from the table that on an average 12 weeks were taken for conducting feasibility studies. Maximum time was devoted to system analysis and system design. In case of feasibility studies, maximum time was taken for conducting economic feasibility and organizational feasibility with average time of 3.6 and 3.33 weeks respectively. It can be seen from the table that legal feasibilities, technical feasibilities and operational feasibilities took average time of 1.71 weeks, 1.70 weeks and 1.42 weeks respectively.

4.4.7.2 Customization of IS

Respondents were enquired about the extent of customization undertaken in the IS package at the time of implementation. Results, thus obtained, have been presented in Table 4.84. It can be seen from the table that majority of the organizations, *i.e.*, 60 percent went for implementation of IS packages without any customization. Out of 28 organizations who undertook customization, 15 organizations reported customization up to less than 20 percent. Eleven organizations, *i.e.*, about 16 percent implemented IS with customization of 20 to 40 percent, while two organizations reported undertaking customization to the extent of 40 to 60 percent. On the basis of the available results, it can be stated that manufacturing organizations largely went for implementation of standard IS packages.

Table 4.84: Level of Customization ($n = 70$)

Level of Customization	Frequency
No Customization	42 (60.00)
Less than 20%	15 (21.42)
20%-40%	11 (15.71)
40%-60%	2 (2.85)

Even in case of organizations who took customization, it can be seen that the extent of customization was quite limited. Customization facilitates running of IS as per the requirement of the user organization. Too much of customization may prove to be costly and also hampers the user organization from getting the benefits of updates on the system available from time to time from the vendors.

Majority of customization was reported in the area of Finance and Accounting (21 responses), followed by Marketing (9 responses) and Information Technology (4 responses).

4.4.7.3 Change management activities

While implementing IS, organizations usually undertake change management activities so as to maximize the benefits available from IS. Respondents were enquired about the change management activities undertaken at the time of implementation of IS. In all, 54 organizations reported undertaking such activities and the results have been shown in Table 4.85.

Table 4.85: Change Management Activities ($n = 54$)

Type of Change Activity Undertaken	Frequency
Adopted Best Practices	36 (66.67)
Partial Process Changes	19 (35.18)
Business Process Reengineering	9 (16.66)

It can be seen from the table that majority of the respondents, who admitted undertaking change management activities, went for adoption of best practices. About 35 percent of

the organizations went for partial process changes. About 17 percent of the respondents reported undertaking Business Process Reengineering before implementation of IS. It can be stated that manufacturing organizations were inclined towards adoption of best practices recommended by the vendors/ consultants at the time of implementation of IS. Only 17 percent of the organizations went for Business Process Reengineering (BPR) before going for the new systems. As per the recommendations of literature related to IS/IT, BPR should be undertaken before going for a new IS/IT application in the organization, but the same phenomenon was absent to a large extent in case of manufacturing organizations in Punjab.

Out of 54 organizations who reported undertaking change management activities, 21 organizations admitted facing problems related to change management. Major problems reported by the respondents were user resistance and lack of financial resources for undertaking change management activities.

4.4.7.4 Conversion strategy

Conversion marks moving from existing systems to new systems. A number of conversion strategies are available for implementation of IS in the organization. Respondents were enquired about the conversion strategy at the time of implementation of IS. It can be seen from Table 4.86 that 30 percent of the organizations went for direct cutover method of conversion, *i.e.*, moving from the existing IS to new IS in sudden manner.

Table 4.86: Conversion Strategy Followed ($n = 70$)

Conversion Strategy	Frequency
Direct Cutover	21 (30.00)
Phase In Method	18 (25.71)
Parallel Systems and Cutover	16 (22.85)
Pilot Approach	15 (21.42)

About 26 percent of the organizations reported use of Phase- In method. In case of Phase- In method, implementation of IS is undertaken in phases instead of sudden cutover to

new system. Twenty three percent organizations used parallel systems and cutover. Parallel systems involve a situation where new and old systems co-exist for sometime before the cutover to new systems. About 21 percent organizations reported running the new system on pilot basis and moved on to new system only after a successful pilot run. As only 30 percent of the organizations went for direct cutover system it can be stated that manufacturing organizations covered by the study were not ready to take the risk of the failure of the newly implemented systems.

Out of 70 organizations, twenty eight organizations, *i.e.*, 40 percent reported on the issue of data conversion. All the organizations who reported undertaking this process stated that data conversion was taken up towards the end of implementation process. It was also observed that vendors were given the responsibility of data conversion and no problem was faced during the process.

4.4.7.5 Project management activities

Respondents were enquired regarding formation of steering committees and project teams for implementation of IS in the organization. Twenty nine organizations, *i.e.*, about 41 percent reported formation of steering committees. Steering committees largely, involved top level managers from Information Technology and Finance and Accounting departments. Reportedly, apart from these two departments, no other department was represented on the steering committees. IS carry organization wide impact and lack of representation from departments such as Marketing, Human Resource and Production indicates lack of user participation during implementation of IS.

Twenty five organizations, *i.e.*, about 36 percent reported formation of project teams for implementation of IS. These project teams consisted of middle and lower level managers from Information Technology, Finance and Accounting and Purchase departments. Project teams were assigned the responsibility of purchase of the required hardware and equipment and managing the routine operations of IS implementation.

4.4.7.6 User training

All the manufacturing organizations trained their employees to work on the systems. Respondents were enquired about the methods of training the users and the available

results have been presented in Table 4.87. It can be seen from the table that the most preferred method for training the users was in-house training as about 66 percent of the respondents reported making use of in-house training to prepare the employees to work on the IS. About 54 percent of the respondents stated that user training was looked after by the system developers and about 43 percent of the organizations covered under the survey reported the use of consultants for user training along with other methods.

Table 4.87: Methods Adopted for User Training (*n* = 70)

Training Method	Frequency
In-house Training	46 (65.71)
Training by System Developers	38 (54.28)
Training by Consultant	30 (42.85)

It can be stated that in-house training was the most popular training method among the manufacturing organizations. Preference of the manufacturing organizations for in-house training may be on account of the advantages associated with the method such as lesser loss of routine work, convenient timings and cost effectiveness.

Twenty five organizations reported user resistance during implementation of IS. Majority of the resistance came in form of users pointing out inadequate skills on their part to use IS (17 responses) and skepticism expressed by the users regarding potential benefits of IS (11 responses). All twenty five organizations from this category reported imparting training to the users as a method for overcoming user resistance, while four organizations also offered monetary incentives to the users for working on IS. From the available results it can be stated that manufacturing organizations were using user training as a tool for tackling user resistance.

4.4.7.7 Top management support

Top management support is quite vital for successful implementation of IS in the organization. Responses obtained with respect to top management support have been

Table 4.88: Participation of Top Management in Project Activities (n = 70)

Activity	Frequency
IS Choice Decisions	67 (95.71)
Project Meetings	65 (92.85)
Reviewing Recommendations of Vendors/Consultants	51 (72.85)
Project Monitoring Involvement	44 (62.85)
Information Requirement Analysis	42 (60.00)

shown in Table 4.88. It can be seen from the results that top management participation was quite high for IS choice decision as well as project meetings, as rate of participation in these activities was 95.71 and 92.85 respectively. Top management personnel also participated actively in reviewing the recommendations received from the vendors and consultants. It was reported that rate of participation in such cases was about 73 percent. Project monitoring activities and information requirement analysis witnessed rate of participation by top level managers at 63 percent and 60 percent respectively. From the available results, it can be stated that IS implementation was considered important by top management personnel in manufacturing sector. Higher rate of participation in project management activities indicated the interest of top management personnel in IS implementation.

An attempt was made to measure the effectiveness of top management support for IS activities on a seven point scale with 7 representing 'High Effectiveness' and 1 representing 'Low Effectiveness'. The results have been shown in Table 4.89.

Table 4.89: Effectiveness of Top Management Support

Mean	5.74
Standard Deviation	0.97
Z	15.01*

*Significant at 1 percent level of significance

It can be seen from the table that mean score for top management support for IS came out to be 5.74. It can be stated that effectiveness of top management support for IS in

manufacturing sector was found to be quite high. Mean score was found to be significantly different from the assumed mean of 4 at 1 percent level of significance.

4.4.7.8 Use of consultants

Out of 70 organizations, 17 (24.28 percent) respondents reported the use of consultants during implementation of IS in the organization.

Table 4.90: Use of Consultants (*n* = 17)

Activity	Frequency
Need Recognition	10 (58.28)
Sourcing	8 (47.05)
Organizational Feasibility	2 (11.76)
Economic Feasibility	1 (5.88)
Technical Feasibility	7 (41.17)
Operational Feasibility	7 (41.17)
Legal Feasibility	1 (5.88)
System Analysis	16 (94.11)
System Design	15 (88.23)
Implementation	16 (94.11)
Evaluation	2 (11.76)

Use of consultants in carrying various IS activities has been shown in Table 4.90. It can be seen from the table that consultants were hired for carrying out tasks such as implementation, system analysis and system design. Apart from these tasks, consultants were also used for need recognition and sourcing of IS. From the available results, it can be stated that manufacturing organizations were making limited use of consultants for IS activities.

4.4.7.9 Expenditure on IS

Respondents from the manufacturing organizations were not ready to share Total cost of ownership as well as annual budget marked for IS. This reluctance may be on part of

policies of the organizations. In all, respondents from eleven organizations disclosed investment in IS. Out of these, seven were having SAP R/3 systems and four reported purchasing IS developed by the local vendors. In case of SAP R/3, organizations reported amount ranging from Rs. 20 million to Rs. 25 million as Total Cost of Ownership. IS developed by the local vendors came up with price tag of Rs. 2 million to Rs. 4.5 million.

This section has presented IS sourcing and implementation practices in the manufacturing sector of Punjab. Manufacturing organizations have reported the major use of IS for the elimination of inefficiencies and inaccuracies. The outsourcing in this sector is limited, the outsourcing of software development activity is maximum and that of data entry activity is minimum. Major reason for outsourcing IS functions has been the access to specialized knowledge and best practices. Security and accuracy were considered the most important factors affecting the purchase of IS and least important factors in this regard were compatibility with the existing applications and pay back period. Manufacturing organizations of Punjab were found to be selective in terms of undertaking feasibility studies and customization of IS. Restricted use of change management activities and also that of external consultants is prevalent. Extent of participation and support of top management has been found to be high.

4.5 EVALUATION OF IS

The following section deals with the evaluation of IS undertaken by the manufacturing organizations covered under the study as well as the factor analysis for identifying the major determinants of evaluation of IS in the manufacturing sector of Punjab.

4.5.1 Evaluation of IS by the manufacturing organizations

Respondents were enquired about the evaluation methods and procedures. From total of 70 organizations, only 22 (31 percent) reported undertaking evaluation of IS and the remaining 69 percent reported that no evaluation at all is taking place in their organizations. Further, out of 22 organizations who reported undertaking evaluation, only two organizations were able to disclose the methods used for the evaluation of IS. These evaluation methods included carrying out system audits and dry runs. It can be

stated from the available results that the manufacturing organizations were not equipped for evaluating IS.

4.5.2 User evaluation of IS

Users were enquired about the performance of IS with respect to a number of factors such as accuracy, quality of content, format, user friendliness, timeliness, consistency, training for use and integration. These issues were presented in form of statements and the respondents were asked to give scores on a scale of 1 to 7, with 7 representing completely agreement and 1 representing complete disagreement. Results thus obtained have been presented in Table 4.91. It can be seen from the table that maximum mean score, *i.e.*, 6.64 was observed for the statement *S1* related to accuracy of the system. As per statement *S2*, it can be seen that the users were satisfied by the system as the mean score came out to be 5.83. Statement related to the sufficiency of the information from IS, *i.e.*, *S9* was placed at third position with mean score of 5.52, while statement *S17*, enquiring about the utility of training for using the IS, was placed at the fourth position with mean score of 5.50.

It can be stated that the users were more satisfied with the accuracy of the system, sufficiency of information from IS and utility of training as compared to other variables. It can also be seen from the available results that the users were having below average level of satisfaction in case of speed of the system. Mean score for the statement (*S13*) related to satisfaction related to speed of the system came out to be 3.76.

Mean score for the statement (*S3*) related to the reliability of the system came out to be 4.56 and statement (*S4*), regarding the provision of exact information by IS was having mean score of 4.70. Although, the users were finding the IS related training useful, yet they felt that adequate training was not being provided as the mean score for statement *S16* was found to be 4.65.

Table 4.91: User Evaluation of IS

Statement	Statement Code	Mean	Std Dev	Z
The system is accurate	<i>S1</i>	6.64	0.59	129.69*
I am satisfied with the accuracy of the system	<i>S2</i>	5.83	0.78	68.00*
The system provides reliable information	<i>S3</i>	4.56	1.17	13.87*
The system provides the exact information needed by me	<i>S4</i>	4.70	1.00	20.29*
Output of system is presented in a useful format	<i>S5</i>	5.45	0.73	57.57*
Layout of output is satisfactory	<i>S6</i>	5.08	0.62	50.49*
The system is user friendly	<i>S7</i>	5.47	0.63	67.63*
It is easy to make system do, what you want to do	<i>S8</i>	5.32	0.70	54.65*
The system provides sufficient information	<i>S9</i>	5.52	0.58	75.95*
The system gives information I need in time	<i>S10</i>	4.76	0.83	26.54*
The system provides up to date information	<i>S11</i>	5.29	0.83	45.05*
Timeliness of the system is satisfactory	<i>S12</i>	5.30	0.80	47.10*
Speed of the system is satisfactory	<i>S13</i>	3.76	1.08	-6.44*
The system seldom breaks down	<i>S14</i>	5.40	0.58	69.96*
In the past on average my work has not suffered because of system breakdown	<i>S15</i>	5.38	0.78	51.28*
Adequate training was imparted to me for using the system	<i>S16</i>	4.65	0.99	19.03*
Training imparted was helpful in using the system	<i>S17</i>	5.50	0.58	74.96*
All departments/sections in the organization are interconnected by the system	<i>S18</i>	4.81	0.88	26.68*
Integration in the organization provided by the system is effective	<i>S19</i>	4.84	0.82	29.69*
The system provides useful information	<i>S20</i>	5.32	0.71	53.88*

* Significant at 1% level of significance, tested against the assumed mean = 4

From the available results, it can be stated that IS in the manufacturing sector were facing the major challenge related to the speed, reliability of information, exactness of information and inadequate training to the users for using IS.

4.5.3 Factor analysis

Factor analysis was used for finding out the principal dimensions on which IS can be evaluated. Response was derived from the respondents on 20 statements (presented in Table 4.91) regarding performance of IS. For finding the major factors that can be used for the evaluation IS, factor analysis was applied to the data. The following discussion deals with issues such as reliability and validity of the set of statements, results pertaining to factor analysis and factor definitions.

Factor analysis was run using SPSS and the results have been discussed as follows. As shown in Table 4.92, the value of Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy came out to be 0.564. KMO value more than 0.50 is an indication of adequate sample size (Field, 2003).

Table 4.92: Values for KMO Measure and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy	0.564
Bartlett's Test of Sphericity	
Approx. Chi-Square	10732.05
Degrees of Freedom	190
Significance	0.00

Value of chi-square for Bartlett's Test of Sphericity came out to be 10732.05. This value was found to be significant ($p=0.00$) with 190 degrees of freedom. Value of KMO and results of Bartlett's Test of Sphericity indicated factor analysis could be performed on the given data set. Results from factor analysis have been presented in Table 4.93 .

Table 4.93: Rotated Component Matrix

	Component						
	1	2	3	4	5	6	7
<i>S3</i>	.913						
<i>S13</i>	.845						
<i>S20</i>	.775						
<i>S18</i>	.710			.407			
<i>S10</i>	.666						
<i>S4</i>	.607					.459	
<i>S2</i>		.789					
<i>S9</i>		.773					
<i>S1</i>		.595					
<i>S12</i>			.817				
<i>S17</i>			.639				
<i>S16</i>				.809			
<i>S7</i>				.778			
<i>S19</i>	.541			.558	.403		
<i>S14</i>					.821		
<i>S6</i>					.764	.428	
<i>S11</i>						.847	
<i>S15</i>						.463	
<i>S8</i>							.929
<i>S5</i>			.405				-.535

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

While extracting the factors Principal Component Analysis was used and rotation method used was Varimax Rotation with Kaiser normalization. In all, seven components were extracted and minimum factor loading used for the analysis was 0.4.

4.5.3.1 Factor definitions

Seven factors were obtained from Principal Component Analysis. Factor loadings and means have been presented in Table 4.94. These seven factors were able to explain 77.302 percent variance in the data set. Factor definitions for the extracted factors have been provided as follows.

(i) Reliability and Speed: This factor deals with precision and speed of IS and explains 23.54 percent variation. Items covered under this factor include reliability, exactness, timeliness, and usefulness of information retrieved from IS, along with the speed of the system and connectivity across different functional areas and departments. This factor covers information characteristics and speed with which the information is available to the users. Factor relates to the basic qualities of information and can be helpful in the evaluation of IS. It can be seen from Table 4.94 that factor mean for this factor came out to be 4.65.

(ii) Accuracy and Adequacy: This factor deals with the accuracy of information provided by IS, satisfaction of users with respect to the accuracy of the information and the sufficiency of information provided by IS. This factor explains degree of accuracy of information as well as the availability of adequate information to the users for making the decisions to carry on their tasks. A good IS is expected to provide accurate and sufficient information to the users for helping them in their managerial jobs. Therefore, this factor can provide useful contribution to the evaluation of IS. It can be seen from Table 4.94 that factor mean for this factor came out to be 5.93. Variation explained by this factor is 14.21percent.

(iii) User Ability: This factor is concerned with the ability of the user to make use of IS and extract the desired information in timely manner. Factor deals with the help provided by user training in using IS. It is expected that user ability will increase with provision of more training to the users. User ability is also concerned with the time in which user is able to extract the required information from IS. User ability can affect type and quality of use of IS, hence, can be used for the evaluation of IS. It can be seen from Table 4.94 that factor mean for this factor came out to be 5.40. variation explained by this factor is 10.73 percent.

(iv) Ease of Use: This factor explains the degree of ease involved in the use of IS. Ease of use is expected to decrease in case of complex IS. This factor covers items such as user friendliness, effective integration and provision of adequate training for using IS. User friendliness of a system directly relates to the ease with which one can work on it. Effective integration across the functional areas ensures the availability of information through a single window, therefore, providing the comfort to the user for operating the

system. Adequate user training adds to the user's acquaintance with the system and the user is less troubled while using the system. Ease of use of a IS makes it more valuable for the users; hence, this factor can be used for the evaluation of IS. It can be seen from Table 4.94 that factor mean for this factor came out to be 4.99. Variation explained by this factor is about 8.58 percent.

(v) Facilitation for work: Availability of IS on the continuous basis and satisfactory output layout facilitate the work. Lack of these items may hamper the working of the users. This factor named 'facilitation for work' deals with the degree of support provided by IS in carrying out the managerial jobs. IS are increasingly being viewed as the utilities and the utilities are primarily focused on facilitating the work. It can be seen from Table 4.94 that factor mean for this factor came out to be 5.24. Variation explained by this factor is about 8.17 percent.

(vi) Maintainability: A well maintained IS is expected to have fewer breakdowns and provides up to date information. Maintenance of IS ensures lesser loss of work on part of lesser down time. Maintainability of IS is also likely to be affected in the absence of IS being up to date. Users expect fewer breakdowns and up to date IS, therefore, maintainability can be an important dimension for the evaluation of IS. It can be seen from Table 4.94 that factor mean for this factor came out to be 5.34. Variation explained by this factor is about 6.56 percent.

(vii) Flexibility: With ever-changing business requirements, the users expect some agility on part of IS. This agility is manifested by the adaptability of IS as well as flexible format of output. Therefore, flexibility can be a desired dimension of IS and can contribute to the evaluation of IS. It can be seen from Table 4.94 that factor mean for this factor came out to be 5.13. Variation explained by this factor is about 5.52 percent.

It can be observed from the above discussion that reliability and speed, accuracy and adequacy, user ability, ease of use and facilitation for work were able to explain about 65 percent of the total variations. Therefore these factors can be used for overall evaluation of IS in the manufacturing sector of Punjab. It can be seen from factor means that IS in the manufacturing sector scored relatively low on reliability and speed as well as ease of use, as factor means for these two factors were 4.65 and 4.99 respectively.

Table 4.94: Extracted Factors

Factor No.	Factor Name	Eigen Value Total	% of Variance	Items	Item Loading	Mean	S.D.	Factor Mean
1.	Reliability & Speed	4.708	23.540	Useful Information (S20)	.775	5.32	0.71	4.65
				Interconnectivity (S18)	.710	4.81	0.88	
				Timely Information (S10)	.666	4.76	0.83	
				Exact Information (S4)	.607	4.7	1	
				Reliable Information (S3)	.913	4.56	1.17	
				Speed of System (S13)	.845	3.76	1.08	
2.	Accuracy & Adequacy	2.841	14.206	System accuracy (S1)	.595	6.64	0.59	5.99
				Satisfaction <i>w.r.t.</i> accuracy (S2)	.789	5.83	0.78	
				Sufficient Information (S9)	.773	5.52	0.7	
3.	User Ability	2.146	10.729	User Training (S17)	.639	5.5	0.58	5.40
				Satisfaction <i>w.r.t.</i> Timeliness (S12)	.817	5.3	0.8	
4.	Ease of Use	1.717	8.583	User Friendliness (S7)	.778	5.47	0.63	4.99
				Effective integration (S19)	.541	4.84	0.82	
				Adequate training for using system (S16)	.809	4.65	0.99	
5.	Facilitation for work	1.633	8.165	Availability of System (S14)	.821	5.4	0.58	5.24
				Satisfactory output layout (S6)	.764	5.08	0.62	
6.	Maintainability	1.312	6.560	Less loss of work due to break down (S15)	.463	5.38	0.78	5.34
				Up to date information (S11)	.847	5.29	0.83	
7.	Flexibility	1.104	5.519	Useful format of output (S5)	-.535	5.45	0.73	5.39
				Adaptability (S8)	.929	5.32	0.70	
Overall Mean for Factors								5.29

Maximum factor mean was for accuracy and adequacy with value pegged at 5.93, followed by user ability with mean value of 5.40 and maintainability with mean value of 5.34. Mean for the factor ‘facilitation for work’ came out to be 5.24 and mean value for ‘flexibility’ came out to be 5.13. From the available results, it can be stated that manufacturing organization should focus on reliability and speed of the systems for improving the performance of IS. More attention is also required to bring out changes so as to increase the ease of use.

It can be seen from the results that IS evaluation is still in its evolution phase in case of manufacturing sector of Punjab. Only two responses were available regarding the methods used for evaluation of IS. Further, these responses were related to testing of the software. Manufacturing organizations of Punjab should make an effort for evaluation of IS with focus on the benefits accruing from these systems. Keeping in view the available data and the present state of IS evaluation in the manufacturing sector of Punjab, the following dimensions are being suggested for the evaluation of IS:

- Reliability and Speed
- Accuracy and Adequacy
- User Ability
- Ease of Use
- Facilitation for work
- Maintainability
- Flexibility

These dimensions broadly focus on both IS and the user. For better performance of IS in the organization emphasis should be placed on improving IS in terms of speed, accuracy, lesser downtime *etc.* as well as the ability of the users.

From the results of this section, it can be inferred that negligible IS evaluation is being undertaken by the manufacturing organizations of Punjab. Further, the methods of evaluation reported by the respondents are technical in nature. Seven factors identified for user evaluation of IS have been reported in this section.

4.6 CHAPTER SUMMARY

This chapter has presented the results obtained in this study. These results have been organized in five sections based on five research questions. First section includes the details of the type and extent of IS usage in the manufacturing sector of Punjab. This section deals with the issues such as the weekly use of IS and computer based applications, extent of IS use in decision making, relative importance of various types of IS, association between the extent of IS use and type of decision and value of IS for various managerial roles and the stages of decision making. Second and third sections deal with the variations in the IS use and computer based applications across different levels and functional areas of management. Fourth section consists of the details of IS sourcing and implementation practices being used by the manufacturing organizations of Punjab. Final section of reports the results obtained regarding the IS evaluation in the manufacturing organizations.

Chapter-5

Summary and Conclusions

The present chapter aims to recollect the various phases of the study. Summary of the research with the main findings has also been presented. Answers to the research questions have been included in this chapter along with the implications of the study. Research contributions from this work have been listed and limitations of the study have also been pointed out. Recommendations based on the study have also been included along with the future work directions in this chapter.

5.1 SUMMARY OF THE STUDY

The present study was undertaken in the manufacturing sector of Punjab for exploring IS use and determining the IS management practices such as sourcing, implementation and evaluation. The study assumes importance in the light of the fact that no such study has earlier been conducted in context of the manufacturing sector of Punjab. Before conducting the study, extensive review of literature was undertaken for finding out the major issues related to IS use and management. The enquiries made in the study were largely related to these major issues identified from the literature review. The study is based on survey of 70 large and medium scale manufacturing units in the state of Punjab. For the purpose of carrying out the study, two questionnaires were developed, *i.e.*, for the organizations and for the users. Questionnaire meant for organization was administered to Managers / Head of Department, looking after IS activities and contained questions pertaining to procurement, implementation and evaluation of IS. Questionnaire for users dealt with issue of extent and type of use of IS. These questionnaires were validated by conducting a pilot survey in five organizations. These questionnaires were finalized by incorporating the suggestions received during the pilot survey. From each organization covered under the study, approximately 2, 4 and 6 respondents were selected from top, middle and lower level of management. Sample size of such respondents was 840. For meeting the objectives of the study, spread of the respondents across different functional areas of management such as Marketing, Finance and Accounting, Production and

Operations, Human Resource and Information Technology was ensured. Appropriate statistical techniques have been used for analysis of data.

5.2 SUMMARY OF THE FINDINGS

The following section deals with the findings of the study. Major findings of the study have been summarized in two parts. First part deals with the use of IS in the manufacturing sector of Punjab and the second part contains IS management practices.

5.2.1 IS use

This section deals with the overall use of IS as well as the comparative use across the levels and functional areas. Further, the main findings pertaining to different levels and functional areas have been listed.

Overall Use of IS

- Respondents were using IS for around 29.50 hours per week.
- Around 64 percent of total decisions being made by the respondents were based on inputs from IS.
- For these decisions sixty-one percent contribution of IS based inputs was observed. Among computer based applications, respondents reported maximum use of word processor and internet, 12.43 hours per week and 11.85 hours per week respectively
- Maximum value of IS was stated for decisional roles with mean of 4.98.
- For decision making stages, maximum value of IS was reported for identification of the problem followed by searching alternatives.
- Use of IS increased in the order of strategic decisions, tactical decisions and operational decisions.
- Mean score of user satisfaction with respect to IS came out to be 5.07.

Comparative Use of IS Across Different Levels

- Top level managers were using IS for around 27 hours per week while middle level managers and lower level managers were using IS for 31 hours and 30 hours

respectively. There was a significant difference across different levels of management in terms of usage of IS.

- Middle level managers were using maximum IS based inputs for making decisions, followed by top level managers and lower level managers.
- For all the levels, it was observed that Management Information Systems, Transaction Processing Systems and Office Automation Systems were considered more important as compared to Executive Support Systems, Knowledge Work Systems and Decision Support Systems.
- For all the levels, IS were being used relatively to more extent in case of short term decisions as compared to medium term and long term decisions.
- Top level managers were comparatively more satisfied with IS as compared to other levels, with average satisfaction score of 5.27. Middle level managers reported satisfaction level at 5.07, while lower level managers reported the same at 5.00.
- There was a significant difference among different levels based on user satisfaction with respect to IS.

Findings for Top Level Managers

- Maximum use was reported for word processor (11.4 hours per week), followed by internet (10.8 hours per week).
- There was significant difference in the usage of various applications in case of top level managers.
- Average value of IS for interpersonal roles came out to be 5.27 followed by decisional roles at 4.96 and informational roles at 4.86.
- Maximum value of IS was reported for problem identification and searching for alternatives with mean scores of 5.89 and 5.52, respectively.

Findings for Middle Level Managers

- Middle level managers reported maximum use of word processor and internet, 12.83 hours per week and 12.35 hours per week, respectively.

- There was significant difference in the use time of various applications in case of middle level managers.
- Average value of IS for interpersonal roles came out to be 5.13 followed by decisional roles at 5.02 and informational roles at 4.84.
- Middle level managers were finding IS valuable for identification of problem and evaluation of alternatives.

Findings for Lower Level Managers

- Lower level managers reported maximum use of word processor and internet at 12.54 hours per week and 11.9 hours per week respectively.
- There was significant difference in the use time of various applications in case of lower level managers.
- Average value of IS for decisional roles came out to be 5 followed by informational roles at 4.80 and interpersonal roles at 4.59.
- Maximum value of IS was reported for problem identification and searching for alternatives.

Comparative Use of IS Across Different Functional Areas

- IT managers were the heaviest users of IS with average weekly usage of around 44.3 hours, followed by managers dealing in the area of finance and accounting with weekly usage of 36.8 hours. Human resource managers and Production managers were comparatively lighter users with weekly usage of 22.1 hours and 21.8 hours respectively.
- There was significant difference across different functional areas of management in terms of use time of IS.
- IT managers and Marketing and Sales managers were using maximum IS based inputs for making decisions, followed by Human Resource managers. Least use was reported in case of Production managers and Finance and Accounting managers.
- There was a significant difference across functional areas in terms of percentage contribution of IS based inputs in decisions involving use of IS.

- IT managers were comparatively more satisfied with IS as compared to other managers, with average satisfaction score of 5.18.
- Out of all the categories minimum satisfaction was reported by marketing managers with score of 4.86.
- For all the functional areas, it was observed that Management Information Systems, Transaction Processing Systems and Office Automation Systems were considered more important as compared to Executive Support Systems, Knowledge Work Systems and Decision Support Systems.
- For all the functional areas, IS were being used relatively to more extent in case of short term decisions as compared to medium term and long term decisions. There was a significant difference among different levels on the basis of satisfaction.

Findings for Information Technology Managers

- Maximum use was reported for word processors (12.68 hours per week), followed by internet (11.91 hours per week).
- There is significant difference in the use time of various applications in case of IT managers.
- Average value of IS support for interpersonal roles came out to be 4.91 followed by decisional roles at 4.89 and informational roles at 4.72.
- Maximum value of IS was reported for problem identification and choice of alternatives.

Findings for Finance Managers

- Finance managers reported maximum use of word processor and internet, 12.28 hours per week and 11.88 hours per week respectively.
- There was a significant difference in the mean use of various applications for middle level managers.
- Average value of IS support for decisional roles came out to be 5.07 followed by interpersonal roles at 4.91 and informational roles at 4.88.

- Maximum value of IS was reported for problem identification and evaluating alternatives.

Findings for Production Managers

- Production managers reported maximum use of word processor and internet at 12.07 hours per week and 11.44 hours per week respectively.
- There was a significant difference in the weekly use of various applications.
- It was found that mean value of IS support for decisional roles came out to be 5.13 followed by informational roles and interpersonal roles with mean values of 4.91 and 4.70 respectively.
- Maximum value of IS was reported for problem identification and searching for alternatives.

Findings for Marketing Managers

- Marketing managers reported maximum use of internet and word processor at 13.37 hours per week and 12.27 hours per week.
- There was a significant difference in the mean use of various applications for marketing managers.
- Average value of IS for informational roles came out to be 4.90 followed by decisional roles at 4.87 and interpersonal roles at 4.86.
- Maximum value of IS was reported for problem identification and ranking and choice of alternatives.

Findings For Human Resource Managers

- Human Resource managers reported maximum use of word processor and spreadsheets with the use of 12.89 hours per week and 11.65 hours per week respectively.
- There was a significant difference in the mean use of various applications for middle level managers.
- Average value of support by IS for interpersonal roles came out to be 5.13, followed by support for decisional roles at 5.01 and informational roles at 4.70.

- Maximum value of IS was reported for identification of problems and searching for alternatives.

5.2.2 IS management practices

The following section contains major findings of the study with respect to IS management practices being followed by the manufacturing organizations in Punjab. Reasons for using IS and practices related to sourcing, implementation and evaluation have been summarized.

Reasons for using IS

- Major reasons for having IS were elimination of inaccuracies and reducing the cost.
- Providing customer service and attaining competitive advantage were part of the secondary priority.

Sourcing of IS

- Software development, development of fully integrated systems and equipment maintenance services were the functions that were relatively highly outsourced, with average level of outsourcing 67.8 percent, 67.3 percent and 66.6 percent respectively.
- Software maintenance, data communication networks and user training education functions were relatively less outsourced, with average level of outsourcing at 44 percent, 48.4 percent and 48.7 percent respectively.
- Respondents preferred in-house services in case of data entry; average level of outsourcing for this activity was 15.6 percent.
- Major reason for outsourcing IS functions was to have access to expertise and best practices (59 responses).
- Prominent reasons for not outsourcing IS functions was availability of in-house skill (68 responses) followed by the security concerns (20 responses).
- Forty three organizations contacted vendors for procuring IS on their own, in 34 cases vendors took the lead to establish contact.

- For 38 organizations level of investment in IS depended upon the final negotiated price with the vendor.
- Thirty two organizations reported making a budget before contacting the vendor and in seven cases external consultants were hired to find out the level of required investment.
- Security, Accuracy, Integrity and Fit with the business were the major factors that affected the selection of IS and vendor with mean scores of 4.72, 4.71, 4.63 and 4.62.
- Return on Investment, Brand, Payback period and compatibility with the existing applications were termed as relatively lesser important with mean scores of 3.46, 3.38, 3.33 and 3.07 respectively.
- Manufacturing organizations were relatively more satisfied with security, accuracy of IS and the experience of the vendors.
- On the other hand, relatively less satisfaction was reported with respect to pay back period, Return on Investment and maintenance of IS.

Implementation of IS

- It was found that organizations were very selective in undertaking feasibility studies. According to findings 14 organizations undertook organizational feasibility, 11 went for economic feasibility, operational and technical feasibility.
- Twenty eight organizations reported for undertaking customization during the implementation process. Majority of customization was reported in case of Finance and Accounting.
- Nine organizations reported undertaking Business Process Reengineering, 36 adopted best practices and 19 undertook partial process changes.
- Conversion strategies largely followed at the time of implementation were Direct and Phase in method.

- Formation of project team for implementing IS was reported by 25 organizations, while 29 organizations reported formation of steering committees.
- Use of consultants during the implementation process was reported by 17 organizations. Consultants were being used largely for system analysis, implementation, system design and need recognition.
- Manufacturing organizations preferred in-house training for the users as 46 responses were received in this regard.
- Majority of the organizations were found to have good involvement of top management in procuring and using IS. On seven point scale (7 being Excellent) mean score for top management support for IS activities came out to be 5.74.

Evaluation of IS

- Only 22 reported evaluation of IS.
- Methods of evaluation of IS were reported by only two organizations. These included carrying out system audits and dry runs.
- Factor analysis was conducted for finding out the dimensions on which IS can be evaluated. The following seven factors were extracted:
 - (i) **Reliability and Speed:** This factor deals with precision and speed of IS.
 - (ii) **Accuracy and Adequacy:** deals with the accuracy and sufficiency of information provided by IS.
 - (iii) **User Ability:** deals with ability of the user to extract information from IS in lesser time.
 - (iv) **Ease of Use:** deals with the user friendliness of IS and training required to use IS easily.
 - (v) **Facilitation for work:** deals with continuous availability of IS.
 - (vi) **Maintainability:** deals with regular updating of IS and fewer break downs.
 - (vi) **Flexibility:** deals with the ease with which a variety of tasks can be performed using IS.

5.3 VERIFYING THE HYPOTHESES

Hypothesis 1 (H1) and Hypothesis 2 (H2) have been presented along with Research Question 2 and Research Question 3, respectively, in section 3.1. Results pertaining to these hypotheses are being summarized as follows:

5.3.1 Hypothesis 1 (H1)

Hypothesis 1: There is no variation in the use of IS across different levels of management.

Table 5.1 presents the results related to H1. It can be seen from this table that out of nine issues related to use of IS, significant variations across the levels are there for five issues and for the remaining four issues no significant variation is present.

Table 5.1: Verifying Hypothesis 1

Issue (Variations across levels)	Result
Weekly use of IS	Significant
Percentage decisions based on IS	Non significant
Percentage contribution of IS input in IS based decisions	Significant
Weekly Use of Word Processor	Non significant
Weekly Use of Spreadsheets	Non significant
Weekly Use of Internet	Significant
Weekly Use of Presentation Graphics	Significant
Weekly use of Database Applications	Non significant
Weekly use of Specific Packages	Significant

As mixed results have been obtained regarding H1, it can be stated that H1 is partially refuted. It can be inferred that there is variation in terms of use of IS across different levels. Different levels are having variations in terms of weekly use of IS, percentage contribution of IS inputs in IS based decisions and weekly use of internet, presentation graphics and specific packages.

5.3.2 Hypothesis 2 (H2)

Hypothesis 2: There is no variation in the use of IS across different functional areas of management.

Results related to H2 have been presented in Table 5.2. It can be seen from this table that out of nine issues related to use of IS, there are significant variations across the functional areas for eight issues.

Table 5.2: Verifying Hypothesis 2

Issue (Variations across functional areas)	Result
Weekly use of IS	Significant
Percentage decisions based on IS	Significant
Percentage contribution of IS input in IS based decisions	Significant
Weekly Use of Word Processor	Non significant
Weekly Use of Spreadsheets	Significant
Weekly Use of Internet	Significant
Weekly Use of Presentation Graphics	Significant
Weekly use of Database Applications	Significant
Weekly use of Specific Packages	Significant

Majority of the results obtained regarding H2, do not support this hypothesis. Therefore, this hypothesis can be refuted. It can be inferred that there is variation in terms of use of IS across different functional areas.

From the above discussion, it can be concluded that there is a significant variation in the usage of IS across different functional areas of management. The same argument is partially supported in case of different levels of management.

5.4 Revisiting the Research Questions

- (vii) *Research Question 1:* What is the extent and type of IS use in manufacturing sector of Punjab?

IS were being used to a considerable extent with average weekly use of 29.5 hours. There was not complete reliance on IS as only 64 percent of total decisions were based on IS. Further, for these 64 percent decisions, contribution of IS based input was 62 percent. Word Processors and internet were the most used computer based applications. Significant association was found between extent of IS use and type of decision. The users relied heavily on IS while making short term decisions and this reliance decreased for tactical and strategic decisions. Management Information and Transaction Processing systems were considered relatively more important as compared to Decision Support Systems and Knowledge Work Systems. IS were

considered more valuable for decisional role and problem identification. The details are available in section 4.1.

(viii) *Research Question 2:* Is there any variation in the use of IS across different levels of management?

Significant differences were there across different levels in terms of weekly usage of IS and contribution of IS inputs in IS based decisions. Significant differences were also observed in the use of internet, presentation graphics and specific packages. The details are available in section 4.2. H1 is partially refuted as mixed results were obtained in this regard.

(ix) *Research Question 3:* Is there any variation in the use of IS across different functional areas of management?

Significant differences were there across different functional areas in terms of weekly usage of IS, percentage of decisions based on IS and contribution of IS inputs in IS based decisions. Significant difference was found in the use of all computer based applications except Word Processor. The details are available in section 4.3. H2 is stands refuted as variations are there in use of IS across different functional areas.

(x) *Research Question 4:* What are the practices used for sourcing and implementing IS by the manufacturing organizations in Punjab?

Limited outsourcing of IS functions was undertaken with maximum level of outsourcing being 68 percent for software development. Insourcing was preferred for data entry. Security and accuracy were the most important factors for procuring IS. Selective use of feasibility studies, limited customization and negligible use of consultants were found during the implementation. Participation of top management in project management activities was found to be high. The details are available in section 4.4.

(xi) *Research Question 5:* How are information systems evaluated in the manufacturing organizations of Punjab?

Negligible evaluation is being done at the organizational level. Seven factors were found as the basis of user evaluation of IS. The details are available in section 4.5.

A complete view of the research including goals, conceptual context, methods, validity, research questions and results has been presented in Fig. 5.1.

5.5 IMPLICATIONS OF THE STUDY

In this section, major implications of the study have been discussed. The implications are covered under the topics of (i) Penetration of IS in the selected pockets; (ii) Efficiency focus; (iii) State of IS use and management in the manufacturing sector of Punjab; (iv) Limited use of IS in decision making and (v) Forgoing potential benefits of IS. A brief discussion on the topics listed above is as follows:

5.5.1 Penetration of IS in selected pockets

As H1 is partially refuted and H2 is substantially refuted, it shows that variations in terms of use of IS were more across various functional levels as compared to variations across different levels of management.

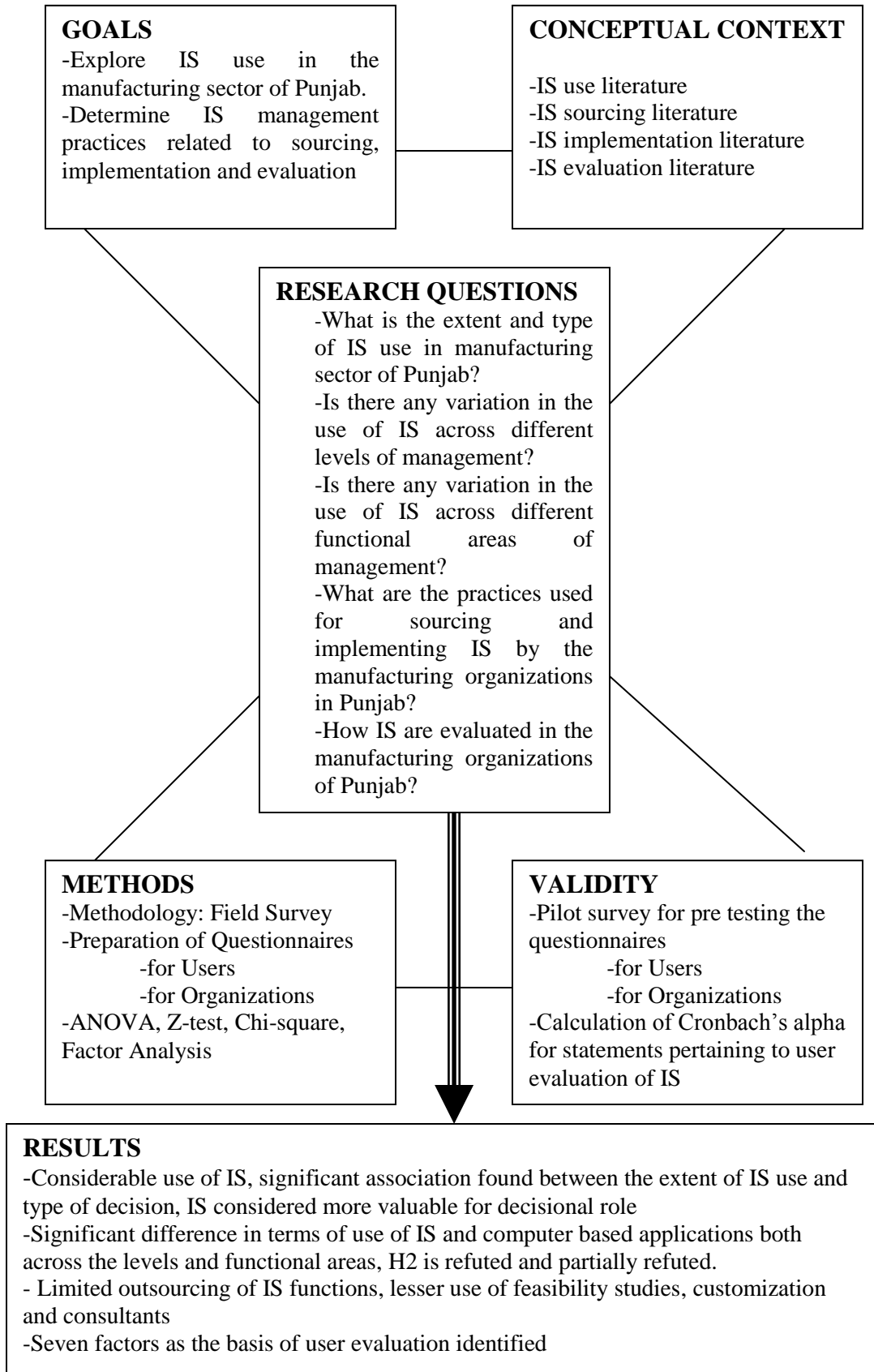


Fig 5.1: Complete View of Research

This phenomenon may find its root in the argument that induction of IS in the manufacturing organizations of Punjab starts from Information Technology, Finance and Accounting departments and then subsequently spreads across other functional areas. In case of functional areas, there is lot of variation in terms of usage rate of IS across the heavy and the light users. This is indicative of difference in the extent of penetration of IS across different pockets in the organization. Absence of uniformity in IS use may be due to non-uniform access to IS across functional areas. Large variations across functional areas may lead to lack in coordination in the organization. Effectiveness in business operations can be brought about by using information systems for seamless working of the enterprise. Lack of co-ordination among different functional areas and the subsystems, is the main cause of friction between functional interfaces, leading to loss of operational effectiveness. Decisions involving multi functional inputs are crucial for inculcating effectiveness in the working of the enterprise.

5.5.2 Efficiency focus

Results from the study indicate that there was a strong efficiency focus in the use of IS and related applications in case of the manufacturing sector of Punjab.

Efficiency orientation in IS use supporting managerial roles

Efficiency concerned managers are more inclined towards decisional roles while effectiveness associated with informational roles (Mintzberg, 1990). Overall value of IS for decisional roles comes out to 4.98 while the values for interpersonal roles and informational roles are 4.89 and 4.83 respectively. Therefore, it can be stated that for the users, the maximum value of IS was in context of decisional roles. The usage of IS by the managers in the manufacturing organizations of Punjab is more oriented towards efficiency as compared to effectiveness. Further, the respondents valued use of IS for different managerial roles moderately. It is an indication that there is scope for improving IS, so that there is an increase in their perceived value.

Efficiency orientation in sourcing IS

At the organizational level, the major reasons cited for having IS were elimination of inaccuracies and inefficiencies as well as reducing the cost. IS were seen as a tool for inculcating efficiency in the working of the organization. Manufacturing organizations were not fully outsourcing IS functions as the maximum level of outsourcing in case of software development came out to be around 68 percent. For a number of IS functions, the level of outsourcing was less than 50 percent. These results indicate that even for deploying IS in the organization cost savings were given priority. Even the quality of services scored a distance third position, when enquired about the reasons for outsourcing IS functions.

Lopsided use of lower order IS applications

Users preferred lower order IS applications such as transaction processing systems and office automation systems to higher order IS applications such as decision support systems and executive information systems irrespective of the level and functional area. The respondents were found to make very limited use of database applications. Another observation from the study was the perception of managers pertaining to more suitability of IS for short term and standardized decisions. There was a considerable decrease in extent of use of IS in case of tactical and strategic decisions.

5.5.3 State of IS use and management in manufacturing sector of Punjab

In comparison to practices followed in the developed nations, the manufacturing sector in Punjab was found lacking in sound IS management practices. Limited effort of planning for sourcing IS, selective use of feasibility studies and services of external consultants are the major reasons for these relatively poor IS management practices. Further, most of the manufacturing organizations were not evaluating IS at all. Even in case of the organizations claiming to evaluate IS, the evaluation methods followed were technical rather than focusing on cost benefit analysis. This tendency in the long run can lead to misdirected investments in IS resulting in lot of wasteful expenditure. Results indicate that use of IS is merely restricted to managing routine office activities and

communication. Majority of the IT applications being put to use fall in the category of Function IT and Network IT, while a lot remains wanted in the field of enterprise IT.

5.5.4 Limited use of IS in decision making

It was observed that about 64 percent decisions of the total decisions were made with inputs from IS. It shows considerable but not complete reliance of the users on IS. About 23 percent and 6.97 percent users respectively reported use of specific packages and database applications. Limited use of IS in decision making may be because of these low figures. Limited use of IS in decision making can be attributed to the fact that India is a developing country and further, the state of Punjab, where the study was conducted, characterizes agrarian economy.

5.5.5 Forgoing the potential benefits of IS

Because of the type of IS use in the manufacturing sector of Punjab and related IS management practice, it can be stated that IS benefits were not being optimized. There is a pertinent need to move from efficiency focus to effectiveness focus by increasing use of database applications and higher order IS. Better IS management practices in the manufacturing sector can be instrumental in providing much needed performance improvements both at the organization level and industry level in the manufacturing sector of Punjab.

5.6 CONTRIBUTIONS OF THE WORK

The contributions of the present study have been listed below.

- It is the first study relating to IS in manufacturing sector of Punjab. An attempt has been made to explore the IS use and management in Punjab including sizable sample of the organizations and the users.
- The study provides a valuable insight, regarding leverage of IS in manufacturing sector of Punjab, for the IS developers/vendors and the consultants. These stakeholders can come up with appropriate offerings/solutions to the manufacturing sector by knowing the segment covered by the study better than before.

- Major attributes affecting the purchase of IS, in the manufacturing sector of Punjab, have been identified.
- The study is a successful attempt in revealing the areas of IS management that require more attention and better management on part of the leaders of the manufacturing organizations in Punjab.
- Dimensions used for evaluating IS by the users in the manufacturing sector have been identified by the study.
- The study suggests that IS is not that extensively used in the manufacturing sector of Punjab. Further, the findings of the study can potentially be a representative of other states of India.

5.7 RECOMMENDATIONS OF THE STUDY

Keeping in view the results obtained from the study and the observations made during the study, a few suggestions are being made. Firstly, manufacturing organizations in Punjab need to move beyond transaction processing and office automation systems. This calls change in orientation towards IS management in the organization. Secondly, more importance should be attached to IS management in the organization. For fulfilling this aim, competent persons with the right skill set to manage IS activities in the organization should be inducted or the external consultants should be hired. Another option available in this regard is use of consultants for IS management in the organization. Thirdly, there is a need for training the users so that maximum gains can be exploited from the use of IS. Efforts should be made to acquaint top managers about the importance of alignment between IS and business activities. Fourthly, there is a need to improve IT infrastructure within the organizations. There were instances where poor quality and outdated hardware were reported in use. Organizations should make an effort to renew and maintain IT infrastructure by infusing more funds. Lastly, for improving the performance, there is a need to have a uniform penetration across all the functional areas.

5.8 LIMITATIONS OF THE STUDY

The following are the major limitations of the study:

1. As the study is based on primary data collected from the respondents, accuracy of the results is limited to the accuracy of information provided by the respondents.
2. An attempt has been made to capture the current practices related to IS in the organizations, as the field of IS is quite dynamic, the results obtained from the study may hold true only for the time window of the study.
3. As the survey method has been used for the study, limitations of survey method naturally become the limitations of the study.

5.8 CONCLUSION AND FUTURE RESEARCH DIRECTIONS

This section presents the conclusion of the study as well as the future research directions. Average use of IS was found to be 29.50 hours per week in this study. On an average around 64 percent of total decisions being made by the respondents were based on inputs from IS. Further, for these decisions sixty one percent contribution of IS based inputs was observed. Maximum use was reported for word processor and internet, 12.43 hours per week and 11.85 hours per week respectively. Use of spreadsheets was reported to be 10.79 hours per week while for database applications weekly usage was reported at 7.95 hours. There was significant difference across different levels of management and different functional areas in terms of weekly use of IS. Hypothesis regarding the variation in the use of IS across different functional areas was substantially refuted and the hypothesis regarding the variations in the use of IS has been partially refuted. This indicates more variations in the use of IS across the functional areas as compared to the levels of management. Managers viewed IS as of moderate importance for supporting their tasks and activities across managerial roles. With in managerial roles, maximum value of IS was attached to carrying out decisional roles followed by interpersonal roles and informational roles. Managers were using IS to large extent for making operational decisions as compared to tactical and strategic decisions and lower level managers were complaining about slow speed and the need for up gradation of the systems.

Major reasons for having IS were elimination of inaccuracies, reducing the cost and integrating various functional areas. Software development, development of fully integrated systems and equipment maintenance services were the functions that were relatively highly outsourced. Level of investment in IS depended upon the final

negotiated price with the vendor. Security, Accuracy, Integrity and Fit with the business were the major factors that affected the selection of IS and vendor. Direct cutover and Phase in methods were the preferred for conversion process. Manufacturing organizations of Punjab were found to be selective in terms of undertaking feasibility studies and customization of IS. Restricted use of change management activities and external consultants was also prevalent. Majority of the organizations were found to have good involvement of top management in procurement and implementation of IS. Negligible IS evaluation was being undertaken by the manufacturing organizations of Punjab. Even in case of the organizations undertaking the evaluation technical methods such as dry runs and system audits were being used. Seven factors for user evaluation of IS have been identified.

Present study is an attempt aimed at preliminary exploration of use, procurement, implementation and evaluation of IS in the manufacturing sector of Punjab. For gaining further insight into IS use and management in the manufacturing sector of Punjab, few future research directions have been listed as follows:

- Comparison of IS related performance for the firms having prepackaged enterprise software with those having software from the local vendors.
- Exploring variations in terms of sourcing and implementation practices in greater depth based on size of the organizations.
- Exploring the reasons for the current state of IS evaluation in the manufacturing organizations.
- Exploring the reasons for the current state of IS sourcing and implementation in the manufacturing organizations.
- Investigating whether comparatively better IS/IT management practices lead to better organizational benefits.

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Annexure-I

Industry-Wise Status of Large / Medium Units as on 31.03.2003

Name of Industry group	No. of Units	Employment	Fixed investment (Cr. Rs.)	Production (Cr. Rs.)
Food Products	115	31953	2452.18	4580.26
Beverages	16	7114	718.25	1236.77
Cotton/Woolen/Synthetic Textile/Dying etc.	126	58441	5795.10	6037.07
Hosiery & Garments	35	11660	777.31	731.47
Paper Products & Printing	32	7766	863.97	801.60
Leather & leather Products	4	2298	47.03	71.63
Rubber & Plastic Products	15	15466	552.43	1064.08
Chemical Products	42	13855	3111.68	5923.70
Non - Metallic Mineral Products	4	637	291.61	570.73
Basic Metal Products	57	12605	899.10	2314.30
Metal Products	11	2698	50.83	147.50
Machinery & Parts Except Electrical	12	6451	503.54	1143.24
Electrical Machinery & Parts	29	7788	972.92	809.41
Transport Equipments & Parts	40	40270	2108.78	3263.66
Misc. Industries	15	2594	197.37	188.97
Total	553	221596	19342.10	28884.39

(Source: Official Web site of Punjab)

www.punjabgovt.nic.in/INDUSTRY/IndustryWisestatus.htm

Date of access: 19/05/2005

Annexure-II

Questionnaire : Organization

Q:1 Does your organization use Computer Based Information Systems (CBIS): Yes / No

Q:2 For how long CBIS are being used by the organization: ----- Years

Q:3 Please tick the important reason (s) for having Computer Based Information Systems (CBIS) in the organization (You may tick more than one)

- For eliminating inaccuracies and inefficiencies in administrative processes
- For integration of various functional areas
- For flawless customer service
- For reducing the cost
- To attain competitive edge in business
- Simply because others are also having CBIS
- Other reasons (please specify):

Q:4 Out of the following Information System functions, which functions are being outsourced.

Function	Percentage of Function		
	Outsourced	In House	Not Used
Software Development	%	%	
Software Maintenance	%	%	
Development of fully integrated system	%	%	
Data Communication Networks	%	%	
Equipment Maintenance Service	%	%	
User Training & Education	%	%	
Data Entry	%	%	
Any other (please specify).....	%	%	

Q:5 Please tick the important reason(s) why IS functions are being outsourced (May tick more than one)

- To have access to specialized knowledge and best practices
- To have better quality service
- For improving the performance
- Lack of skill & expertise with in the organization
- To have cost effectiveness
- Because of time constraints
- Other reasons (please specify):.....

Q:6 Please tick the important reason(s) why IS functions are **not** being outsourced (May tick more than one)

- Because of security risk
- To avoid commoditized functions
- In-house availability of skill & expertise
- Other reasons (please specify):.....

Q:7 For outsourcing how contact was established with the vendors

- Vendors approached on their own
- Vendors were approached by you
- Requirement/tender was floated
- Any other (please specify):.....

Q:8 How many vendor(s) did you select/consider for CBIS:

Q:9 How the level of investment was decided for CBIS

- Budget was made prior to contact with the vendors
- As percentage of turnover
- As per negotiated final price by the vendor
- Consultant was hired to find the required level of investment
- Any other (please specify):

Q:10 According to different buying roles please fill the following :

Buying Role	Department	Level (Top/Middle/Lower)	Designation	Individual/Group Decision
Initiator				
Influencer				
Decider				
Buyer				

Q:11 Before purchasing CBIS :

- Vendor(s) made presentations at your place Yes No
- You visited Vendor's place Yes No
- On site running of the system was seen Yes No
- Trial version of the system was seen/used Yes No

Q:12 How much time was taken for the following

Need Recognition	Activity Done	Approx Time (Weeks)	Activity Carried by Whom?
Organizational Feasibility	<input type="checkbox"/> Yes <input type="checkbox"/> No		
Economic Feasibility	<input type="checkbox"/> Yes <input type="checkbox"/> No		
Technical Feasibility	<input type="checkbox"/> Yes <input type="checkbox"/> No		
Operational Feasibility	<input type="checkbox"/> Yes <input type="checkbox"/> No		
Legal Feasibility	<input type="checkbox"/> Yes <input type="checkbox"/> No		
System Analysis	<input type="checkbox"/> Yes <input type="checkbox"/> No		
System Design	<input type="checkbox"/> Yes <input type="checkbox"/> No		
Implementation	<input type="checkbox"/> Yes <input type="checkbox"/> No		

Q:13 Please tick the following attributes according their importance while selecting CBIS and the vendors

Attribute	Extremely Important	Very Important	Important	Less Important	Not Important at all
Price					
Compatibility with existing applications					
Features					
Reputation					
Time					
Experience					
Scope of Customization					
Relevance to Business					
Maintenance					
Domain Knowledge					
Return on Investment					
Payback Period					
Accuracy					
Fit with business					
Integrity					
Brand					
Security					
Any other (please specify).....					

Q:14 How do you rate performance of CBIS and vendor after using CBIS

Attribute	Excellent	Very Good	Average	Below Average	Poor
Price					
Compatibility with existing applications					
Features					
Reputation					
Time					
Experience					
Scope of Customization					
Relevance to Business					
Maintenance					
Domain Knowledge					
Return on Investment					
Payback Period					
Accuracy					
Fit with business					
Integrity					
Brand					
Security					
Any other (please specify).....					

Q:15 What was the extent to which the package was customized

- Fully tailored made as per requirement of the organization
- More than 80%
- 60%-80%
- 40%-60%
- 20-40%
- Less than 20%
- No customization/ Standard package was implemented as such

Q:16 Please state the major areas where customization was used

Functional Area	CBIS being used	Extent of Customization (%age)
Marketing & Sales	<input type="checkbox"/> Yes <input type="checkbox"/> No	
Finance & Accounting	<input type="checkbox"/> Yes <input type="checkbox"/> No	
Production & Operations	<input type="checkbox"/> Yes <input type="checkbox"/> No	
Human Resource Management	<input type="checkbox"/> Yes <input type="checkbox"/> No	
Research & Development	<input type="checkbox"/> Yes <input type="checkbox"/> No	
IT/Systems	<input type="checkbox"/> Yes <input type="checkbox"/> No	
Any other (please specify).....		

Q:17 Please state the major purpose of customization

Q:18 (a) Was there any steering committee for implementation of CBIS? Yes No

Q:18 (b) If yes, who were the members of the steering committee:

Name	Designation	Department

Q:18(c) Briefly specify the roles and authority of steering committee

Q:19(a) Before or during implementation of CBIS was any change management activity was taken up: Yes No

Q:19(b) If yes, what type of activities were taken up:

- Business Process Reengineering before CBIS
- Process changes according to best practices suggested/ required by CBIS
- Partial process changes and partial customization of CBIS
- Any other(please specify).....
-

Q:19(c) Did you face any problems pertaining to change management ? Yes No

If yes, please specify the major problems faced:

Q:20 (a) While implementing CBIS in your organization which conversion strategy was followed:

- Parallel Systems & Cutover
- Direct Cutover
- Pilot Approach
- Phase In Method
-

Q:20 (b) Why the given strategy was followed :

Q:20 (c) Did you face any problem during the conversion process? Yes No

If yes, please state the major problems faced:

Q:21 (a) Was there any project team for implementation of CBIS? Yes No

Q:21 (b) If yes, who were the members of the project team:

Name	Designation	Department

Q:21(c) Briefly specify the roles and authority of project team

Q:22 Was any training provided to users for using CBIS? Yes No

If yes, who provided the training?

Trainer	Used	Duration of Training (Hours)
Consultants	<input type="checkbox"/> Yes <input type="checkbox"/> No	
System Developers/Implementers	<input type="checkbox"/> Yes <input type="checkbox"/> No	
Members of the organization trained by Consultants/Developers/Implementers	<input type="checkbox"/> Yes <input type="checkbox"/> No	
Any other (please specify).....	<input type="checkbox"/> Yes <input type="checkbox"/> No	

Q:23(a) Did the users offered any resistance in implementation/use of CBIS? Yes No

Q:23(b) If yes, what form of resistance was offered and what was done to overcome the resistance?

Q:24 Did top management (or any representative of their's) participate in the following activities

Activity	Participation	Extent of Participation		
		Regular	Frequent	Seldom
Project Meetings	<input type="checkbox"/> Yes <input type="checkbox"/> No			
Information Requirement Analysis	<input type="checkbox"/> Yes <input type="checkbox"/> No			
Reviewing Recommendations of consultant /vendor	<input type="checkbox"/> Yes <input type="checkbox"/> No			
CBIS Choice Decision	<input type="checkbox"/> Yes <input type="checkbox"/> No			
Project Monitoring Involvement	<input type="checkbox"/> Yes <input type="checkbox"/> No			

Rate the effectiveness of top management support for CBIS

High 7 6 5 4 3 2 1 Low

Q:25 (a) Did the organization take help of outside consultants for CBIS? Yes No

Q:25 (b) If yes, please mention the role of the consultant as per the following matrix

Activity	Involvement of Consultant	Role of Consultant	
		Advisory	Activity completely outsourced to consultant
Need Recognition	<input type="checkbox"/> Yes <input type="checkbox"/> No		
Sourcing	<input type="checkbox"/> Yes <input type="checkbox"/> No		
Organizational Feasibility	<input type="checkbox"/> Yes <input type="checkbox"/> No		
Economic Feasibility	<input type="checkbox"/> Yes <input type="checkbox"/> No		
Technical Feasibility	<input type="checkbox"/> Yes <input type="checkbox"/> No		
Operational Feasibility	<input type="checkbox"/> Yes <input type="checkbox"/> No		
Legal Feasibility	<input type="checkbox"/> Yes <input type="checkbox"/> No		
System Analysis	<input type="checkbox"/> Yes <input type="checkbox"/> No		
System Design	<input type="checkbox"/> Yes <input type="checkbox"/> No		
Implementation	<input type="checkbox"/> Yes <input type="checkbox"/> No		
Evaluation	<input type="checkbox"/> Yes <input type="checkbox"/> No		

Q:26(a) Is CBIS evaluated in your organization? Yes No

Q:26(b) If yes, what are the methods used

Method	Frequency	Person(s) Responsible	Designation	As Individual/Committee Member

Q: 27 What is approx annual budget for CBIS? Rs.....

Q:28 To what extent users are satisfied with existing CBIS?

Satisfied 7 6 5 4 3 2 1 Dissatisfied

DESIGNATION OF THE RESPONDENT:

Phone/Mobile No.:

THANKS A LOT FOR SPARING YOUR PRECIOUS TIME

Annexure-III

Questionnaire: Users

Dear respondent, the information being collected is purely for research and academic purpose and shall be kept confidential for all purposes

Designation:

Present Functional Area:

- Finance & Accounting Human Resource Management
 Sales & Marketing Research & Development Production & Operations
 IT/Systems Any Other (Please specify).....

Q:1 Do you use Computer Based Information Systems (CBIS) in your organization

- Yes No

(Please proceed if answer to Q: 1 is yes)

Q:2 On the average , how many hours per week you actually use a terminal/ CBIS for information which is essential for your job responsibilities

- More than 20 hours 15-20 hours 10-15 hours 5-10 hours Less than 5 hours

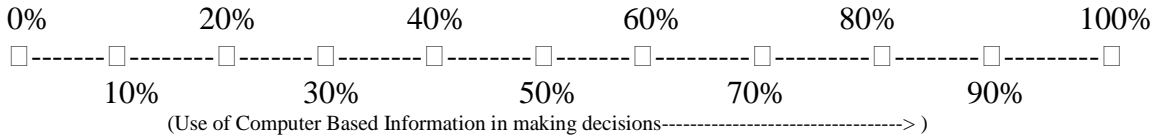
Q: 3 Indicate average number of hours per week you use each of the following:

- | | Hours Per week |
|--|----------------|
| • Stand Alone Personal Computer | ----- |
| • PC or other terminal connected to an online centrally located computer system/LAN/Internet | ----- |
| • Any other hardware being used.....
(please specify) | ----- |

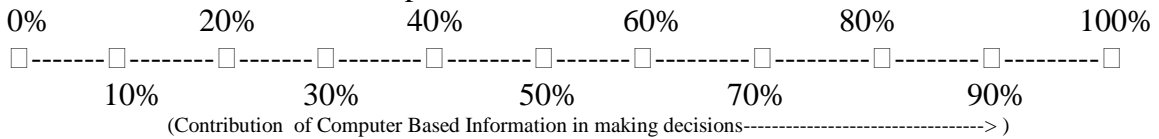
Q:4 Please indicate the average time in hours/week that you use each of the following to support your job responsibilities along with their importance

Applications	Hours per week	1: Not Important 7: Most Important						
		1	2	3	4	5	6	7
Word Processor (MS-word etc.)								
Spread Sheets (MS-Excel etc.)								
Presentation Graphics (Power Point etc.)								
Internet								
Database Applications								
Specific Packages/Developed Applications								
Writing/Running/ Debugging own Programs								

Q:5 (a) How much of decision making is done on basis of Computer Based Information and Non-Computer Based Information



Q:5 (b) Out of decisions in which computer information is used , on an average how much contribution is from computer based information



Q: 6 For each of managerial roles performed by you, please indicate the value of Computer based information

Role & its description	7: Great Value 1: No value at all , 0: Role does not apply to me							
	7	6	5	4	3	2	1	0
Entrepreneur (related to initiating changes)								
Monitor (Receiving & collecting information)								
Resource Allocator (choosing where to spend efforts)								
Disseminator (transmitting information in the organization)								
Disturbance Handler (dealing with threats to organization)								
Negotiator (Negotiating on behalf of organization)								
Figurehead (representing organization /department in all matters of formality)								
Liaison (interacting with peers and people outside the organization)								
Leader (Managing relation with subordinates)								
Spokesperson (disseminating organization's information to its environment)								

Q:7 For each of the following decision making steps please indicate the value of CBIS

Decision Making Stages	7: Great Value 1: No value at all ,							
	7	6	5	4	3	2	1	0
Identifying opportunities/problems								
Generating alternative courses of action								
Evaluating the alternatives								
Ranking of alternatives & choice								
Implementing the chosen alternatives								

Q:8 Out of the following, indicate the percentage use of computer based information while making decisions

Type of Decision	Use of computer based information					
	More than 80%	60%-80%	40%-60%	20%-40%	Less than 20%	No Use at all
Long Term Strategic						
Medium Term Tactical						
Short Term Operational						

Q9: Out of the following information systems rank in order of importance as per your use

Type of system & its description	Rank
Transaction Processing System (performing & recording daily routine transactions)	
Office Automation System (Word Processing, Imaging of documents,e-mail,fax)	
Knowledge Work System (Creation & integration of new data/information)	
Management Information System (information for planning ,controlling, decision making)	
Decision Support System (providing support to decisions but not automating them)	
Executive Support System (used for non routine strategic decisions)	

Q:10 For the following statements please indicate your choice (by recording (√) in the cells against the statements)with respect to systems you use :

Statements	7: Completely Agree						
	1: Do not agree at all						
	7	6	5	4	3	2	1
The system is accurate							
I am satisfied with the accuracy of the system							
The system provides reliable information							
The system provides the exact information needed by me							
Output of system is presented in a useful format							
Layout of output is satisfactory							
The system is user friendly							
It is easy to make system do, what you want to do							
The system provides sufficient information							
The system gives information I need in time							
The system provides up to date information							
Timeliness of the system is satisfactory							
Speed of the system is satisfactory							
The system seldom breaks down							
In the past on average my work has not suffered because of system breakdown							
Adequate training was imparted to me for using the system							
Training imparted was helpful in using the system							
All departments/sections in the organization are interconnected by the system							
Integration in the organization provided by the system is effective							
The system provides useful information							

Q: 11 List down the problems you face/ have faced with information systems in the Organization

Problems	Frequency		
	Always	Frequently	Less often

Q:12 What type of changes you desire in the existing information systems

.....

.....

.....

.....

Q: 13 Overall indicate your level of satisfaction with information systems in the organization

Extremely Satisfied 7 6 5 4 3 2 1 Extremely Dissatisfied

THANKS A LOT FOR SPARING YOUR PRECIOUS TIME

Annexure-IV

List of Publications

Refereed International/National Journals

1. Dharni, K., Sharma, R.K. and Kiran, R. (2009) 'Information systems in Indian manufacturing: Extent of use and support for managerial roles', *International Journal of Business Information Systems*, Vol. 4, No.6, pp. 673-687.
2. Dharni, K., Kiran, R. and Sharma, R.K. (2009) 'Information systems and decision making across functional areas in manufacturing sector', *Business Perspectives*, Vol. 11, No. 1, pp. 47-54.
3. Dharni, K., Kiran, R. and Sharma, R.K. (2009) 'Use of computer based applications: A study at different levels of management', *The Icfain Journal Management Research*, Vol. 8, No. 7, pp. 45-55.
4. Dharni, K., Kiran, R. and Sharma, R.K. (2008) 'Use of computer based applications across functional areas of management', *Gyan Management*, Vol. 2, No. 2, pp. 103-116.

Conference Paper

1. Dharni, K. and Kiran, R. 'Competitiveness of Indian Manufacturing: Technology and integration issues' in National Conference 'Managing Change for Organizational Excellence' December, 2007, GJIMT, Mohali.